ORDER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

7100.10

12/27/93

SUBJ: **AIR TRAFFIC IMPLEMENTATION PLAN FOR THE USE OF THE GLOBAL POSITIONING SYSTEM**

1. PURPOSE. This order provides the overall strategy for the integration of the Global Positioning System (GPS) into the air traffic control (ATC) system, and the appendices serve as the implementation plan to be used by Air Traffic to effect the integration.

2. DISTRIBUTION. This order is distributed to branch levels in Washington and regional Air Traffic Divisions, FAA Academy, FAA Technical Center, all Air Traffic field offices and facilities.

3. BACKGROUND. This order provides the framework and guidance for the development of an air traffic system that uses satellite-based navigation and for the integration of the Global Positioning System into the National Airspace System. While the scope of the plan is strategic in nature, the objectives and associated initiatives identify and establish areas that Air Traffic must focus on in order to immediately take advantage of existing capability and provide users with a return on their equipage investment. The mid- and far-term initiatives in the plan provide broad insight into the future of the Global Navigation Satellite System. The plan has sufficient flexibility and latitude to take advantage of the dynamics of satellite technology. The plan will be implemented by the Communications, Navigation, and Surveillance (CNS) Staff, ATP-20.

4. RESPONSIBILITIES.

a. The Director, Air Traffic Rules and Procedures Service, (ATP-1), through the following principal agents, has the overall responsibility for the implementation of this order.

(1) ATP-20 will serve as the focal point for those objectives and initiatives that have multifunctional responsibilities which preclude a single office of primary interest (OPI) at the Air Traffic level. ATP-20 shall ensure that appropriate coordination is effected among the offices within the national headquarters, the regional Air Traffic Divisions, and, when applicable, air traffic field facilities.

(2) The Procedures Division (ATP-100) and the Airspace-Rules and Aeronautical Information Division (ATP-200) shall be responsible for ensuring that all taskings and requirements for their respective offices, associated with an initiative or objective in this order, are accomplished.

b. The Office of Air Traffic System Effectiveness (ATH), through its principal agent, the Quality Assurance Division (ATH-200), shall be responsible for ensuring that quality assurance issues are addressed in all proposed changes in policy, separation standards, procedural development, and other areas which may have an impact on system effectiveness.

c. The Office of Air Traffic System Management (ATM), through its principal agents, Civil Operations Program (ATM-100), the Air Traffic Control System Command Center (ATM-200), and Military Operations Program (ATM-400), shall be responsible for ensuring that all taskings and requirements for their respective offices, associated with an initiative or objective in this order, are accomplished.

d. The Air Traffic Plans and Requirements Service (ATR), through its principal agent, the Advanced Systems and Facilities Division (ATR-300), shall be responsible for ensuring that all taskings and requirements for their respective offices, associated with an initiative or objective in this order, are accomplished.

e. The Office of Air Traffic Program Management (ATZ), through its principal agent, the Training Requirements Program (ATZ-100), shall be responsible for ensuring that all taskings and requirements for their respective offices, associated with an initiative or objective in this order, are accomplished.

for William H. Pollard
Associate Administrator for Air Traffic

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The purpose of the Air Traffic Implementation Plan for the Use of the Global Positioning System (GPS) is to identify the steps needed to enable the Federal Aviation Administration (FAA) to develop air traffic control (ATC) procedures which will exploit the navigational capabilities of GPS. The plan contains five major objectives, each designed to be satisfied through the accomplishment of a series of Air Traffic initiatives. The methodology for accomplishment of each individual initiative is stated in that initiative'stechnical approach. The technical approach includes requirements for cost/benefit analyses, planning considerations, tests or demonstrations, procedural changes, and training, as well as coordination among the appropriate organizations within and outside the FAA.

The GPS is a satellite-based positioning, navigation, and time-transfer system developed by the Department of Defense (DOD). Using a constellation of 24 satellites, unaffected by weather, GPS provides highly accurate, en route, terminal, and approach navigational guidance to GPS-equipped users. The GPS navigational concept is based on accurate and continuous knowledge of the spatial position of each satellite in the system. Using great-circle-navigational concepts, GPS receivers automatically select the appropriate satellites in view and translate the signals into a three-dimensional position. This position is based on velocity, time, and referenced to a common grid (latitude/longitude) system. Without augmentations, such as differentials, the system provides civil users horizontal accuracies of 100 meters with 95 percent confidence and 300 meters with 99.99 percent confidence.

The inherent benefits of GPS to the overall ATC system will initially be limited but will steadily increase as the flying public increasingly adopts GPS and equips aircraft with approved GPS avionics. Oceanic ATC procedures will be the initial area where GPS will have a significant impact. As user equipage increases, the transition will continue exploiting the flexible nature of GPS to improve the flow of air traffic in oceanic, en route, and terminal environments, with specific applications in rotorcraft operations. The ultimate goal is the declaration of a GPS airspace based solely on this highly accurate satellite-based navigational system and not constrained by limitations of land-based navigational aids (NAVAID).

GPS will be introduced within the National Airspace System (NAS) in three phases:

First, GPS will be used as a supplemental navigational system in the NAS (Near Term 1994). Current navigational systems will still be required on the ground and in the aircraft when GPS is being used. Early applications will include supplementing current area navigation (RNAV) capabilities and GPS overlays of current instrument approach procedures. Direct routes and helicopter routings based on GPS will be introduced during this phase.

In the second phase, GPS navigation will initially remain supplemental in nature but will steadily transition into a primary means of navigation in the NAS (Mid Term 1995-1998). Initial augmentations to enhance accuracy and integrity, such as wide (WDGPS) and local (LDGPS) area differentials, will be used when available. Here Air Traffic initiatives will be designed to allow expanded use of GPS in the current VOR/DME-based NAS but with reduced reliance on these land-based systems. During this phase, Category I and II approaches, tracking aircraft on the airport surface, reduced separation standards, and the Aeronautical Telecommunications Network (ATN) will be implemented into the NAS.

The final phase will equate to full conversion to GPS navigation, augmented for primary use in the NAS, without reliance on current land-based NAVAID's (Far-Term 1999 and beyond). The airspace and air traffic structure should be based on GPS. Sole means GPS, enhanced with increased use of augmentations, will be used. This capability will be fully exploited in the areas of navigation, obstacle and terrain clearance, instrument approach, separation standards, and surveillance. Category III approaches, time separation, and domestic automatic dependent surveillance (ADS) implementation can be expected during this phase.

The plan stipulates that the FAA will implement an incremental and evolutionary process by which the ATC system will meet the needs of an expanding GPS navigational capability by the users.

The five major objectives which this plan is designed to satisfy are as follows:

Develop ATC services and procedures at locations where GPS will provide a new or expanded capability. Enhance flexibility of GPS navigation, not constrained by line of sight or range limitations of land-based NAVAID's, through the expansion of instrument flight rules (IFR) services to a significant number of new locations. Identify required resources, especially additional controller personnel, to ensure the handling of additional requirements, that is, requests for expanded Class E airspace, new instrument procedures, etc. Establish a GPS-based terminal structure to include a flexible system of standard instrument departures (SID), standard arrival routes (STAR), and instrument approach procedures (IAP).

Exploit the use of GPS to establish a more efficient oceanic ATC system. Restructure the oceanic ATC system to include reduced separation standards and increased system capacity. Implement this objective through continuous coordination with adjacent ATC service providers and the International Civil Aviation Organization (ICAO).

Exploit the use of GPS to establish a more efficient domestic en route ATC system. Restructure the current ground-based-navigational-airway system to one that is satellite oriented, to provide several benefits which include: reduced separation standards, flexible/direct routes, and a more efficient use of airspace.

Exploit the use of GPS to establish a more efficient terminal ATC system. Reduced separation criteria benefits include reduced distance between runways for parallel operations and improved aircraft sequencing procedures, enhancing those initiatives set forth in FAA's Center TRACON arrival sequencing (CTAS) program. In addition, GPS with augmentations will be used to track aircraft and vehicles on an airport surface to an accuracy of 1 to 3 meters.

Use the capabilities of GPS to provide enhanced and more precise air traffic services for rotorcraft operations. Exploit GPS to allow rotorcraft to maximize the use of direct, efficient routing without adversely affecting fixed-wing traffic and ATC. This will include establishment of "rotorcraft only" STAR's, SID's, and IAP's with emphasis placed on steep angle approaches to enhance a simultaneous fixed-wing/rotorcraft mix. Such will enhance public-use facilities, as well as police and hospital heliports, for example.

Air traffic controller training will be of paramount importance throughout the implementation of this plan. Preliminary briefings on GPS will begin in early 1994 when headquarters FAA personnel will provide informal GPS briefings on theory and operations to a selected number of large facilities. Videotapes and handouts will also be used to brief this information. The initial procedural training may be accomplished through FAA

Briefing Guides. As the incremental advances in GPS and other aspects of satellite technology occur, the development of formalized training courses must be given consideration. This plan specifies within each initiative where training must be developed and what coordination is required to accomplish each task.

FAA has established an office of primary interest, ATP-20, for ensuring the accomplishment of all implementation strategy through management, and implementation guidance and ensuring the identified actions of other involved organizations are completed.

APPENDIX 3 - PLAN OVERVIEW

1.0 BACKGROUND

The FAA, in conjunction with ICAO, has acknowledged that the primary navigational system of the future will be provided by a Global Navigation Satellite System (GNSS). GNSS will be composed of one or more satellite constellations of which GPS is a viable candidate. Since GPS is owned and operated by the United States, GPS is the focus of initial FAA satellite efforts. To exploit the enhanced navigational capability of GPS, the FAA established the FM's Satellite Navigation Program. This implementation plan is the blueprint for Air Traffic's support of this program.

GPS Overview: The GPS is a satellite-based-radio-navigational, positioning, and time-transfer system and is comprised of three major segments:

- **Space:** When fully deployed, the space segment will contain 24 operational satellites in 6 orbital planes of 4 satellites each at an altitude of 10,900 nautical miles. The satellites complete 1 orbit in approximately 12 hours. The satellites are positioned in orbit so that a minimum of four satellites are observable by a user anywhere on earth. Each satellite contains highly accurate atomic clocks for synchronization of the pseudocode messages used by the aircraft receivers to compute distance from the satellites which are used in position determination.

- **Control:** The GPS control segment consists of a master control station located in Colorado Springs, Colorado, five monitor stations, and three ground antennas at various locations around the world. The control segment controls the operation of the satellites through a series of techniques used to monitor satellite health, correct clock errors, maintain satellite location, and exchange and update navigational data, as well as other maintenance functions.

- **User:** The user segment consists of the GPS receivers and equipment used by surface vehicles and aircraft. The receivers, knowing the position of the satellites, can determine its position by measuring the time the satellite signal takes to reach the receiver and converting that length of time to distance. Normally, measurements from four satellites are required for an accurate three dimensional (3D) navigational solution.

GPS, operated by the DOD, offers two levels of service; the standard positioning service (SPS) and the precise positioning service (PPS). However, PPS is limited to authorized U.S. and allied military, Federal Government, and specified civil users. PPS uses an encrypted mode of transmission with significantly higher accuracy levels. Civil users are authorized use of SPS and are guaranteed 100 meter accuracy with 95 percent confidence and 300 meter accuracy with 99.99 percent confidence. GPS accuracy levels are degraded by DOD for national security reasons through a technique called selective availability (SA).

The FAA's Flight Standards Service (AFS) has approved the use of GPS for oceanic, domestic en route, terminal IFR operations, and nonprecision approaches within U.S. airspace or other airspace as authorized by the FAA as stated in AFS-1 and AIR-1 memorandum "IFR Approval of Use of Global Positioning System (GPS) Operations." Declaration of an initial operational capability (IOC) of the GPS constellation is anticipated for early 1994. Prior to IOC, certain operations using GPS navigation have been authorized by FAA in accordance with the above-referenced memorandum. To further

clarify operator requirements, the FAA is scheduled to publish in early 1994 Advisory Circular (AC) No: 90-XX, Guidelines for Using GPS Equipment for IFR En Route, Terminal and Nonprecision Instrument Approach Procedure Navigation in the U.S. National Airspace System (NAS).

Transition Projects: In accordance with the above FAA guidance, the following projects and development efforts are currently underway in order to maximize the initial use of GPS in conjunction with IOC and further efforts toward development of a GPS-airspace system.

Fiji Project: The FAA is sponsoring a "proof of concept" demonstration in the nation of Fiji, where Fijian airspace is being used to validate the feasibility of a GPS-based airspace system. The project includes GPS-equipment installation in all domestically registered aircraft, establishment of GPS routes and cloudbreak procedures, implementation of special GPS-flight procedures, data collection requirements, validation of special air traffic procedures, and validation of waypoints for GPS navigation. The results of this demonstration will aid in determining the strategy to transition U.S airspace to a GPS-based system.

GPS Overlay Program: This program uses GPS to overlay current nonprecision approaches and is to be implemented in three phases. Phase I, which began in June 1993,, is transparent to air traffic in that conventional avionics and ground-based NAVAID's must be available and operating for the pilot.' Phase II will occur after IOC and differ from phase I by only requiring the aircraft's avionics be available, but not operating, and that ground NAVAID's be operational. Phase III authorizes the procedures be flown with only GPS avionics and the term "G-P-S" be included in the phraseology when clearing an aircraft for the approach. These selected nonprecision IAP's must be named "GPS" approaches, in addition to the current published designations.

Differential Techniques: While the inherent accuracies of GPS make it more than satisfactory for nonprecision approach applications, other factors including atmospheric distortion and selective availability preclude use for precision approaches without augmentations to enhance accuracy and integrity. Various forms of differential concepts are being developed, which in effect transmit navigational corrections to the airborne receiver, resulting in accuracies suitable for precision applications. Satellite-based integrity broadcasts, GPS integrity channel (GIC), as well as wide and local area differential reference stations are current methods under development.

Special Category I Approaches (SCAT-I): In conjunction with the Requirements and Technical Concepts for Aviation (RTCA), Incorporated's Minimum Aviation Systems Performance Standards (MASPS) for SCAT-1 Approaches, initial applications of differential techniques will be used on a user-specific basis, where the users, providing their own differential reference station, will be allowed to perform precision approaches to Category I minimums. Initially, SCAT-1 approaches are planned for
Aspen and Steamboat Springs, Colorado; Houston and Dallas-Fort Worth, Texas; and Juneau, Alaska.

2.0 PURPOSE

The purpose of this implementation plan is to exploit and implement GPS technology in the field of ATC. The plan addresses the implementation in three phases: (1) air traffic applications for the use of GPS as a supplemental navigational system in a NAS that is still VOR/DME based; (2) air traffic

applications for the use of GPS navigation augmented for supplemental and primary use in a NAS that is still VOR/DME based; and (3) air traffic applications for the use of GPS navigation augmented for primary use in the NAS. This plan identifies and examines the benefits of GPS to both user and provider and articulates in detail an implementation strategy that provides for a safe and orderly transition into the GNSS by Air Traffic.

The GNSS will be a worldwide-position and time-determination system. GNSS includes one or more satellite constellations, user receiver equipment, and a system of integrity monitoring function. The system will be augmented as necessary to support the required navigational performance (RNP) concept for a wide range of specific operations within en route (domestic and oceanic) and terminal airspace. GNSS is an evolving system and will provide the aviation community the primary navigational system for the 21st Century.

This plan also identifies, develops, and implements the necessary air traffic standards, rules, regulations, and procedures to provide operational benefits to those aircraft equipped with satellite-based navigational systems. This strategy specifies tasks, and milestones and provides for test and evaluation.

3.0 OBJECTIVE

The overall objective of this plan is to define in detail an implementation strategy that utilizes GPS to enhance the ATC system by creating a seamless, continuous airspace with common procedures and standards to separate aircraft in the en route, terminal, and oceanic environments. The potential benefits will enhance the capacity, service, and safety, and will reduce delays within the current ATC system. Specific objectives include the following:

3.1 Develop ATC services and procedures to locations where GPS will provide a new or expanded capability .

3.2 Exploit the use of GPS to establish a more efficient oceanic ATC system.

3.3 Exploit the capability of GPS to establish a more efficient domestic en route structure.

3.4 Exploit the use of GPS for terminal ATC operations.

3.5 Use the capabilities of GPS to provide enhanced and more precise air traffic services for rotorcraft operations.

4.0 PLAN ORGANIZATION

This plan addresses the overall actions required to enable Air Traffic to meet each increase in user capability and navigational performance realized from GPS technology. During the development of the plan and coordination with the Air Traffic organizations, the Office of Air Traffic System Management, ATM-l, stated that close coordination would be required with all of the Air Traffic services to ensure that the resources needed to accomplish each initiative were available and that the time lines were realistic and considered the requirements of international coordination. The Office of Air Traffic System Effectiveness, ATH-1, stated its requirement to be involved and represented during discussions and planning for personnel/equipment requirements and all procedural changes. Although the individual initiatives do not specifically address the requirements stated by ATH-1 and ATM-l, the

broad language and overall strategy of the plan task ATP-20 to ensure that all appropriate coordination is effected.

4.1 Each of the plan's five objectives is supported by a series of initiatives which are designed to satisfy the objective by addressing operational enhancements, constraints, and assumptions anticipated through the use of the new GPS-based navigational capability.

4.2 The process to fulfill and implement each initiative is stated through a recommended technical approach. The process lays out a methodology which addresses several areas which include: identification of costs versus benefits resulting from the initiative, t&t plan development, ATC procedural development, establishment of training requirements, and required coordination within and outside FAA. Overall management and oversight of the plan implementation will come from the FAA's CNS Staff, ATP-20.

4.3 Throughout each initiative, there are several prevalent institutional issues which may impact the accomplishment of the initiative, but due to their repetitive nature, they will not normally be stated in the technical approach. However, these issues must be addressed by the implementation team. They are as follows:

Environmental Considerations: The added flexibility of GPS navigation will affect the environmental examination process. The anticipated proliferation of new instrument procedures caused by the adoption of GPS will create new environmental challenges. This is due, in part, to the introduction of IFR flying to areas not previously exposed to low altitude aircraft operations. It is imperative that plan implementers fully examine the environmental impact of each step of the implementation process.

Collateral Technologies: GPS, a navigational sensor, will not, in and of itself, satisfy all the initiatives stipulated in this plan. Full exploitation of GPS, in many cases, requires integration with other technologies to fully achieve the goal established in each initiative. For example, GPS-based reductions of separation standards cannot fully be realized without combining surveillance and communications enhancements, such as those contained in ADS, and reliance on aspects of the Air Traffic Advanced Automation System (AAS). Consideration of these collateral technologies is also consistent with establishment of the role GPS will play in the development of the GNSS.

Rulemaking Actions: The significant number of changes to airspace and route structures, as well as instrument approach and departure procedures precipitated by GPS, have the potential to cause a significant increase in rulemaking actions. Plan implementers must ensure that the potential for rulemaking actions be considered in the accomplishment of each initiative.

Charting Changes and Aerodrome Surveys: Many of the initiatives have the potential to create a significant demand for aerodrome surveys and major changes to aeronautical charts. Plan implementers must consider the impact of each initiative in these two areas, that is, survey teams are a limited resource, charting cycles are not easily changed, and adequate lead times are essential. Further, early identification of requirements is essential to ensure budgetarysupport. ATP-20 shall ensure that all appropriate coordination is effected with the Cartographic Standards Branch, ATP-220.

5.0 PHASES OF IMPLEMENTATION

The Air Traffic Implementation Plan for the Use of the GPS will be implemented in three phases:

5.1 Air traffic applications for the use of GPS as a supplemental navigational system in a NAS that is still VOR/DME based. (Near-Term (1993-1994)) -- This first phase addresses GPS as a supplemental navigational system. Receiver autonomous integrity monitoring (RAIM) or an equivalent integrity that is equal to or better, than RAIM will be required in GPS avionics in order to meet Technical Standard Order (TSO) C-129 specifications. Current navigational systems are still required on the ground and in the aircraft when GPS is being used. Early transition will start in a transparent configuration which will mirror present-day operations such as the nonprecision overlay project. During this timeframe, pure GPS nonprecision approaches will be developed and implemented, reaching full maturity in phase II. MASPS SCAT-l approaches also emerge in this phase, but will only be available for private use. Minimum operational performance standards (MOPS) will be approved for use of GPS as a primary navigational source for oceanic flight but will not be used dramatically until oceanic automation materializes in phase II.

5.2 Air traffic applications for the use of GPS navigation augmented for supplemental and primary use in a NAS that is still VOR/DME based. (Mid-Term (1995-1998)) -- The second phase identifies Air Traffic initiatives designed to allow GPS as a supplemental and primary means of navigation in today's NAS that is based on VOR/DME. To encourage continued transition to satellite navigation, FAA approval of GPS equipment, as a substitution for conventional navigational equipment with the anticipated operational benefits for its use, will be the foremost driver to early voluntary equipage. The early transition must be based on voluntary equipage. To achieve an orderly and rapid transition to GPS, the parallel technologies of conventional and satellite navigation must be accommodated.

During this phase, the transition from supplemental navigation to primary means will expand. GPS will be approved for primary use over oceanic areas and will be used on a regular basis. Pure GPS approaches (nonprecision) will be common place. WDGPS will be implemented and Cat-I type approaches will begin to emerge using WDGPS for integrity and accuracy. Precision approaches will become available for public use using LDGPS. GIC will begin to replace RAIM for integrity. Reductions in ATC separation standards will be initiated. Air traffic rules and procedures will be changed to take advantage of the full benefits of GPS.

Transition will require changes in the basic concept of operation in order to achieve maximum benefits of the GPS technology. The magnitude of this change necessitates a transition process that accommodates parallel operation of GPS and non-GPS during a defined period. To minimize the disruptive influence on current systems or services, operational implementation of GPS must be introduced in an evolutionary and incremental manner. Therefore, the use of GPS in the NAS must not be dependent upon total systemwide acceptance before commencing initial GPS operation.

5.3 Air traffic applications for the use of GPS navigation augmented for primary sole means use in the NAS. (Far-Term (1999 and beyond)) -- The applications of sole means implementation of satellite navigation are those specific applications in which new technologies, to include augmentations and enhancements like ADS, ATN, and GPS differentials, can improve capacity, enhance efficiency, and improve the safety of air

operations beyond the near-term applications. These applications will be applied in the areas of navigation, obstacle clearance standards, instrument approach procedures, separation standards, surveillance, communications, and procedural identification and development.

During phase III, GPS will be authorized for sole means navigation. GPS, in association with ADS and pseudo-ADS, will begin to replace radar. Traditional NAVAID's will be decommissioned, and GPS will probably be mandated by Federal Aviation Regulations (FAR) changes. The tunnel concept will be in full operation allowing simultaneous parallel approaches to runways separated by less than 3,000 feet. Separation will be developed to take advantage of the precise time inherent in GPS. Four dimensional standards will begin to emerge. Automation will provide the capability for controllers to become system managers. Intervention by exception will become a standard requirement of ATC.

APPENDIX 4 - PLAN OBJECTIVES

1.0 DEVELOP ATC SERVICES AND PROCEDURES TO LOCATIONS WHERE GPS WILL PROVIDE A NEW OR EXPANDED CAPABILITY.

1.1 INITIATIVE: Structure a flexible system of SID's and STAR's to more efficiently transition to/from the en route structure.

1.1.1 This initiative takes advantage of the flexibility of GPS navigation through creation of potentially unlimited numbers of departure and arrival routes, limited only by environmental, terrain, and airspace considerations, and not constrained by NAVAID limitations. The overall benefit in developing these GPS-based profiles is to ease the transition between the en route and terminal airspace environments for arriving and departing aircraft. Not having the limitations of land-based NAVAID's, SID's based on GPS will be more flexible and add to the ease of entry into the en route flow. GPS arrival profiles will represent an extension of the profile descent concept and take advantage of the point-to-point nature of GPS navigation which is not dependent on land-based NAVAID's. This will provide an aircraft a direct route from the en route structure to the final approach course, normally without intervention from the controller. **(Near/Mid-Term)**

1.1.2 TECHNICAL APPROACH: The flexibility that GPS affords should be the basis for development of universal models of GPS-based SID's and STAR's. A preliminary departure model has been established through the Eagle and Gunnison flight management system (FMS) trials. These trials, along with the interim criteria for establishing FMS and GPS instrument procedures (FAA Order 8260.xx (Draft)), should be the basis from which to expand procedural development. The adaptation of this model using the ideas taken from charted visual flight procedures is an aspect which also dictates further study. The accomplishment of this initiative will be heavily dependent on tests and simulation as well as an indepth airspace analysis on a national, regional, and local level.

1.1.2.1 Benefits and/or costs: Potential benefits include, but are not limited to:

- An effective method to provide efficient routing to aircraft from the terminal area to the en route structure which more effectively deals with the real-time concerns of en route weather avoidance, flow restrictions, preferred departure routes, etc.

- Enhanced service will be provided to outlying and satellite airports adjacent to the terminal area through GPS capabilities. This will yield an increase in IFR terminal capacity by taking advantage of increased runway availability at satellite facilities where GPS will provide departure and arrival navigation.

1.1.2.2 Develop a test plan/demonstration: ATP-20, in coordination with ATP, ATM, ATR, AFS, and the regions, will ensure the development of test plans, evaluation of criteria, and determine test locations, if required. Previous FMS testing should be used as a basis from which to continue development. Emphasis should be placed on exploiting the flexibility of a GPS-based SID/STAR structure. Modeling of the arrival profiles should be based on concepts derived from FMS test data. Testing of this initiative should be integrated with current efforts underway in development of

Terminal Air Traffic Control Automation (TATCA). ATP-20 shall also ensure that this initiative is fully coordinated with the responsible FAA offices, appropriate agencies, and user groups outside the FAA. This coordination will include AFS and Aviation System Standards (AVN) to ensure obstruction clearance criteria are developed for GPS-based SID's and STAR's. The test plan should include but not be limited to:

- Complete initial airspace analysis and cost/benefit study.
- Develop generic GPS-based departure and arrival models, conduct simulation, and publish results.
- Conduct and publish results of operational tests at specified terminal facilities.
- Develop regional implementation plans for establishment of published GPS-based SID's and STAR's through coordination among Air Traffic Divisions, ATM, AFS, AVN, and ATP.

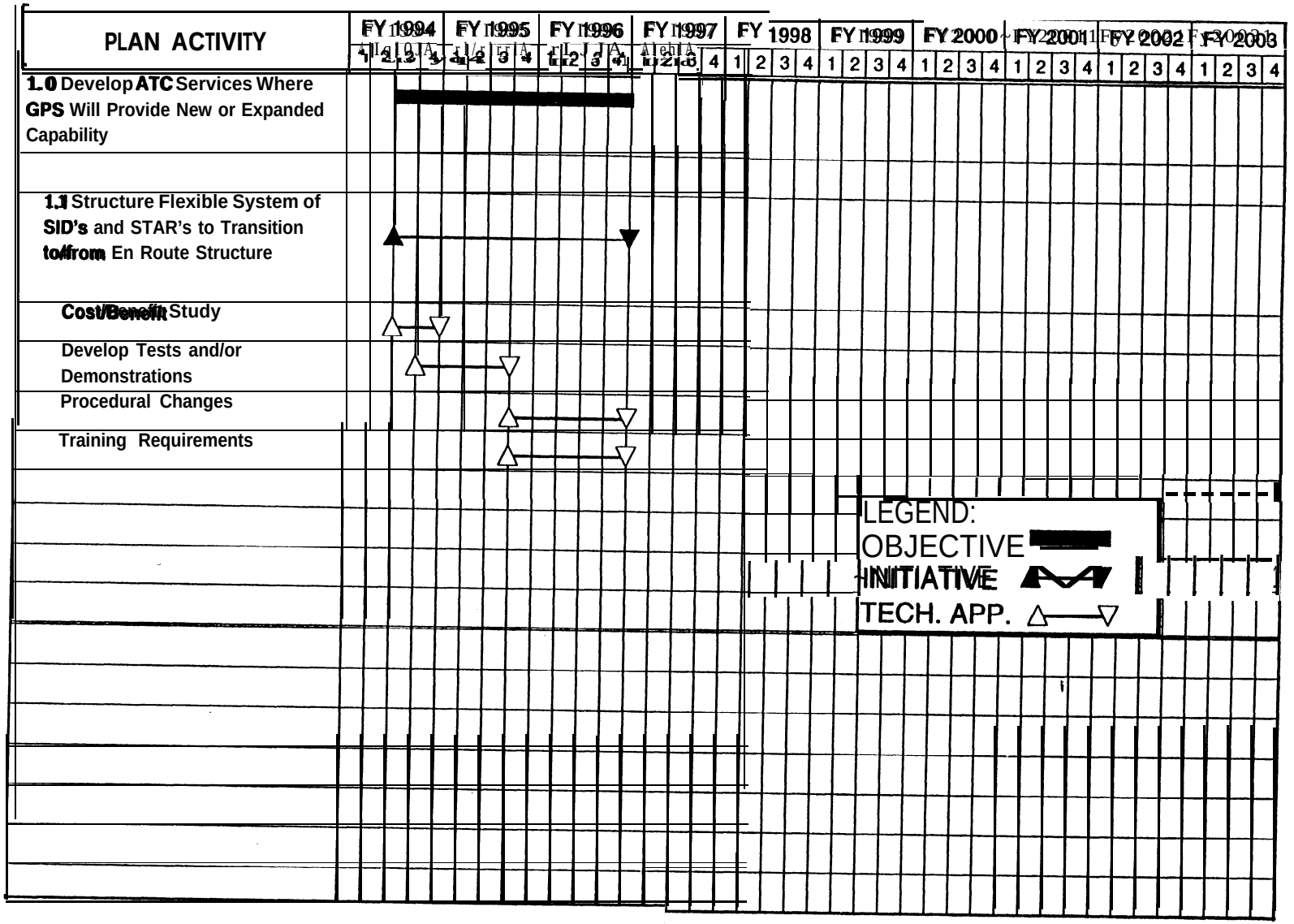
1.1.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: Using the results of the survey and the GPS System Requirements Analysis Report, dated September 30, 1993, ATP-20 will ensure that studies are conducted to recommend editorial and procedural changes, to all FAA orders, manuals, and directives. ATP-20 shall ensure these changes are forwarded to ATP-200 for publication with sufficient lead time to meet planned navigational and equipment implementations. This will be an ongoing process accomplished in an incremental and evolutionary fashion consistent with advances in aircraft equipage as well as ATC facility enhancements.

1.1.2.4 Training requirements for air traffic **controllers: ATP-20** will ensure coordination with ATZ to develop those recommended changes to procedures and directives resulting from these tests in sufficient time to develop and provide the required training directives and curriculum to the appropriate regional offices, field sites, and the FAA Academy.

1.1.2.5 Final coordination requirements: ATP-20 will maintain contact with all tasked offices and provide managerial oversight to ensure the task milestones in this initiative are met. Continuous coordination with the Terminal Procedures Branch, ATP-120 shall be maintained to ensure all aspects of the terminal ATC environment are addressed.

1.1.3 INITIATIVE CONSTRAINTS: The flexible aspects of GPS-based departure and arrival profiles in the terminal environment have the potential to expand, both horizontally and vertically, the terminal airspace structure. The environmental impact of creating routes over areas not previously subject to significant air traffic must be addressed in the airspace analyses.

OBJECTIVE 1.0 - DEVELOP ATC SERVICES AND PROCEDURES TO LOCATIONS WHERE GPS WILL PROVIDE A NEW OR EXPANDED CAPABILITY



2.0 EXPLOIT THE USE OF GPS TO ESTABLISH A MORE EFFICIENT OCEANIC ATC SYSTEM.

All the initiatives contained in this section pertain to international airspace. Their implementation involves and affects adjacent air traffic service (ATS) providers, non-US-certificated aircraft, ICAO, and ICAO-member states.

To achieve maximum international compatibility with both equipment capabilities and procedures, ICAO, ICAO-member states, and ATS-provider states, as appropriate, should:

- Participate in developing and accomplishing tests/trials and/or demonstrations.
- Participate in evaluating the results of the tests and demonstrations.
- Ensure results are made available to member states, nonparticipating ATS providers and airspace users for their information and, where appropriate, for inclusion in their individual implementation plans and strategies.
- Coordinate a concurrent effective date for implementation of revised standards and/or procedures.
- Certify the use of GPS as a supplemental navigational system.
- Determine the requirement for an ICAO-approved flight plan identifier for GNSS-navigational equipage and reduced vertical separation minima (RVSM) certified capability.
- Develop an annex amendment which requires operators of approved GNSS-capable aircraft and/or RVSM-certified aircraft to include the assigned identifier as part of the filed flight plan.
- If deemed necessary, develop contingency procedures which should be followed by pilots operating with reduced separation minima in a mixed GPS/non-GPS environment, as well as a GPS-only environment, when flight conditions dictate immediate deviation from an ATC clearance.
- Review and modify, as appropriate, ATC and operator guidance material such as Document 4444, Procedures for Air Navigation Service (PANS) and Regional Supplementary Procedures, which contains ICAO approved/recommended procedures and standards and recommended practices.

Benefits derived from GPS equipage by airspace users and ATS providers will be limited in the near term. Benefits will increase as the ATC system is upgraded with new capabilities. New system capabilities include ADS, oceanic data link (ODL), enhanced situation display (ESD), conflict probe, and other automation enhancements. The new capabilities are planned to be phased in during the mid- and far-terms. Each system upgrade will enhance ATC system efficiency and provide increased benefits.

ATP-20, in initiating the technical approach identified in each initiative, shall accomplish the following:

- Identify and review all cost/benefit studies which have been completed by FAA, ICAO-

member states, or airspace users. If additional studies are required, ATP-20 will coordinate with ATM-100, ATR-300 and other FAA offices, as appropriate, to establish study requirements and criteria.

- Review all tests and demonstrations that may have taken place by FAA, ICAO-member states, or airspace users. ATP-20, in conjunction with ATP-140, ATM-100, ATR-300 and ICAO (if required) will jointly develop test and/or demonstration plans and select test sites within FAA and/or ICAO regions. An evaluation of equipment and other resources, including financing, to support the test and/or demonstration will be conducted. New tests and demonstrations should include the results of any previous tests and/or demonstrations, GPS equipage, the availability of other satellite-based technology, and, where applicable, ATC system integration of satellite and ground-based technology.

- Ensure that ATZ thoroughly understands the planned changes so all required training is identified, developed, and disseminated to affected regional and field sites within established timeframes.

The following initiatives outline a strategy to take advantage of the benefits GPS provides to improve the overall efficiency of the oceanic ATC system. While not specifically addressed in each initiative, plan implementers must also monitor and, if necessary, establish requirements to merge parallel advances in surveillance techniques to fully take advantage of GPS as it applies to the future CNS environment. Examples of these aspects of surveillance include ADS and pseudo-ADS and the individual components of these systems, such as data link, controller displays, communication systems, etc. Advances in the Advanced Oceanic Automation System (AOAS), ATN, ODL, ESD, telecommunications processor (TP), and similar Air Traffic initiatives must also be considered. Without application of these collateral technologies, the benefits of the enhanced navigational accuracy of GPS cannot be optimized.

2.1 INITIATIVE: Exploit the use of GPS to effect a reduction of longitudinal- and lateral-separation standards and to reduce separation between tracks.

2.1.1 Reduced longitudinal- and lateral-separation criteria and reduced separation between tracks will permit ATC to increase the assignment of aircraft on, or closer to, prime (core) tracks, routes, and altitude/s resulting in increased system capacity and a more cost efficient flight operation. **(Mid/Far-Term)**

2.1.2 TECHNICAL APPROACH: ATP-20, in coordination with ATM-110, ATR-330, AFS-440, ATP-140, ARD-20, and ASE-6 (Oceanic Standards Team (OST)), in conjunction with ICAO, must evaluate and establish new longitudinal- and lateral-separation minima in oceanic airspace. The new separation minima must be supported by an acceptable target level of safety (TLS). FAA tests and demonstrations should be based on RNP criteria using GPS equipage and include satellite- and ground-based technology availability depicted in the December 1992 FAA document "Oceanic ATC Concept of Operations for 1995 at the New York, Oakland, and Anchorage Oceanic Centers." New separation standards may be implemented at various stages as improved technology and/or ground enhancements become available.

2.1.2.1 Benefits and/or costs: User benefits will include cost savings due to more frequent assignment of flight operations on, or in close proximity to, optimum routes,

tracks, and flight levels. Also, increased system capacity will permit additional flight scheduling capability.

2.1.2.2 Develop a test plan and/or demonstration: Results and progress to date of the ongoing ARD-20 Oceanic R&D Study No. 2.4 by the MITRE Corporation for achieving reduced oceanic separation standards should be included in tests and demonstrations developed to:

- Determine methodology for analyzing and developing two-way data link as the optimum mode for controller intervention.
- Determine if conflict probe can be used as sole source for separation.
- Determine and establish new longitudinal- and lateral-separation minima.
  - Separation minima should be reduced as system upgrades are fielded. For example, a reduction to 30 miles lateral and 5 minutes longitudinal should be considered for implementation in the mid-term with subsequent reductions based on mid- and far-term system upgrades.
  - The new lateral-separation standard will be used to determine separation between tracks.
- Establish requirements for implementing cruise climb clearances.
- Ensure new separation minima are supported by an acceptable TLS.
- Develop strategy and timelines for implementing Initiative 2.1.
- Determine, while evaluating longitudinal-separation minima, if the application of DME-separation minima currently being applied by ATC based on land NAVAID's could be applied based on GPS equipage.
- If required, determine cost/benefit to airspace user and ATC provider.
- Establish contingency procedures to ensure safety of flight is maintained in the event of a failure or reduction in system capability. Both airborne and ground failure or degradation must be considered.

ATP-20 and ATM-100 shall ensure results from test plans and/or demonstrations are incorporated into implementation plans and strategies.

2.1.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20, in coordination with ATM-100, ICAO, and ATP-140, shall ensure the development of procedures which will supplement ICAO Documents 4444 and 7030 and FAA Order 7110.65 for use while conducting tests and demonstrations.

Based on the results of joint FAA and ICAO-sponsored tests, ATP-20 shall coordinate with ATP-140 to revise FAA Order 7110.65, Chapter 8, which contains longitudinal- and lateral-separation minima and separation between tracks information and procedures.

2.1.2.4 Training requirements for air traffic controllers: ATZ, in conjunction with ATP-20, shall determine what training curriculum for applying new procedures is required. ATZ shall ensure required dissemination and training are accomplished for revised separation standards and ATC procedures described in FAA orders, manuals, and directives.

2.1.2.5 Final coordination requirements: ATP-20 shall ensure, through ATP-140 and ATP-200, that all aeronautical charts and procedural and editorial changes are published and disseminated within the coordinated timeframes.

2.1.3 INITIATIVE CONSTRAINTS: The extended time requirements to accomplish required ICAO coordination will cause some delay in implementation. Also, in the near-term system, the lack of advanced oceanic automation and direct pilot/controller communications will limit the capacity of the system and will inhibit large separation reductions.

2.2 INITIATIVE: Exploit GPS to increase the use of a flexible offset oceanic track/route capability that will increase capacity on or near high density tracks/routes.

2.2.1 Because of reduced separation between tracks achieved by Initiative 2.1, new offset tracks/routes can be located in closer proximity to the core ATS routes. Offset tracks/routes established in this manner permit ATC service providers to increase system capacity and reduce mileage when reroutes are required. **(Mid/Far-Term)**

2.2.2 TECHNICAL APPROACH: ATP-20, in conjunction with appropriate ICAO panels, will establish ATC procedures to increase ATC usage of a flexible offset track/route system in oceanic airspace. ATP-20, in conjunction with ATM and ICAO, must initiate tests and demonstrations to evaluate and determine required procedures. Tests and demonstrations should be based on GPS equipage, the availability of other satellite-based technology, and ATC system integration of satellite- and ground-based technology.

2.2.2.1 Benefits and/or costs: Airspace users benefit by cost savings due to increased system capacity and reduction of undesirable and costly reroutes.

2.2.2.2 Develop a test plan and/or demonstration: Results and progress of the ongoing Oakland Center dynamic aircraft route planning trials, the ARD-20 Oceanic R&D Studies No. 2.2, DARPS and 4.1, End to End System Simulation, should be included in tests and demonstrations. The tests or demonstrations will be structured to:

- Consider using the trial amendment function of the Oceanic Display and Processing System to establish new routes.
- Identify and develop improvements in air-to-ground and ground-to-ground communications.

- Evaluate computer human interface.
- Develop ATC procedures for establishing ATS routes with associated offset routes.
- Develop implementation strategies and timelines for implementing this initiative.
- Develop contingency procedures to ensure safety of flight in the event of a failure or reduction in system capability. Both airborne and ground failure or degradation must be considered.
- As required, determine other costs/benefits to airspace user and ATC provider.

2.2.2.3 Develop necessary ATC procedural and/or editorial changes required to support **the initiative: ATP-20,** in coordination with ATM, **ICAO,** and **ATP-140,** shall ensure the development of procedures which will supplement **ICAO** Document **4444** and FAA Order **7110.65** while conducting tests and demonstrations.

Based on the results of joint FAA and **ICAO-sponsored** tests or demonstrations, **ATP-20** shall coordinate with **ATP-140** to revise FAA Order **7110.65.**

2.2.2.4 Training requirements for air traffic controllers: ATZ, in conjunction with **ATP-20,** shall determine if a training curriculum for applying new procedures is required. **ATZ** shall ensure required dissemination and training are accomplished for revised **ATC** procedures described in FAA orders, manuals, and directives.

2.2.2.5 Final coordination requirements: ATP-20 shall ensure, through **ATP-140** and **ATP-200,** that all aeronautical charts and procedural and editorial changes are published and disseminated within the coordinated timeframes.

2.2.3 INITIATIVE CONSTRAINTS: There is a lack of advanced automation and limited communications capability for oceanic operation.

2.3 INITIATIVE: Establish ATC procedures for providing improved service to GPS-equipped aircraft operating in a mixed environment of aircraft with and without GPS equipment.

2.3.1 During "transition, " oceanic **ATS** providers must consider a "mixed environment" wherein **GPS-equipped** aircraft will be operating in the same airspace with **non-GPS-equipped** aircraft. **ATC** will provide reduced separation minima between **GPS-equipped** aircraft and standard separation minima between all other aircraft. (Near- **through Far-Term)**

2.3.2 TECHNICAL APPROACH: ATP-20, in conjunction with ATM and **ICAO,** will establish procedures to provide improved **ATC** service **for GPS-equipped** aircraft in a mixed navigational **equipage** environment. **ATP-20** with **ATR-300** and **ATM-100,** in conjunction with other **ATS** providers, should initiate tests and demonstrations to evaluate and establish required procedures which permit reduced separation minima between **GPS-equipped** aircraft.

Tests and demonstrations should include phases of incremental increases in GPS equipage, the availability of other satellite-based technology, and ATC system integration of satellite and enhanced ground-based technology.

2.3.2.1 Benefits **and/or** costs: Users will attain cost savings due to more frequent assignment of flight operations on, or in close proximity to, optimum routes, tracks, and flight levels. Also, increased system capacity will permit additional flight scheduling capability.

2.3.2.2 Develop a test plan and/or demonstration: The tests or demonstrations will be structured to evaluate and determine procedures for separating GPS-equipped aircraft from other GPS-equipped aircraft with reduced separation minima in the same area with non-GPS-equipped aircraft. Non-GPS-equipped aircraft would be separated from GPS and non-GPS-equipped aircraft using standard separation minima. Through test and simulation:

- Evaluate the effect of separating GPS-equipped aircraft from other GPS-equipped aircraft using a reduced separation minima.
- Evaluate the effects of assigning altitude strata for GPS-equipped aircraft only. Strata should be chosen which minimally affects non-GPS-equipped aircraft.
- Determine feasibility of establishing routes for only GPS-equipped aircraft.
- Determine ways to minimize detrimental effects on non-GPS-equipped aircraft.
- Consider that aircraft will be equipping with GPS over a phased period.
- Evaluate the conflict probe function as a controller aid.
- Standardize procedures between flight information regions/control areas (FIR/CTA).
- Develop improved ATC intervention capability based on two-way data link.
- Develop strategies and timelines for implementing this initiative based on information derived from test and simulation.
- Revise or develop, as appropriate, ATC guidance material which contains procedures and separation minima to be applied by ATC service providers in a mixed-equipage environment.
- Review and develop, as necessary, contingency procedures to ensure safety of flight is maintained in the event of a failure or reduction in system capability. Both airborne and ground failure or degradation must be considered.

2.3.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20, in coordination with ATM, **ICAO,** and **ATP-140,** shall ensure the development of procedures which will supplement **ICAO** Document **4444** and FAA Order **7110.65** while conducting tests and demonstrations.

Based on the results of joint FAA and **ICAO-sponsored** tests or demonstrations, **ATP-20** shall coordinate with **ATP-140** to revise FAA Order **7110.65.**

2.3.2.4 Training requirements for air traffic controllers: ATP-20 shall coordinate with **ATZ** to ensure the development of a training curriculum for applying new procedures. **ATZ** shall ensure required dissemination and training have been accomplished for revised **ATC** procedures described in FAA orders, manuals, and directives.

2.3.2.5 Final coordination requirements: ATP-20 shall ensure through **ATP-200** that all aeronautical charts and procedural and editorial changes are published and disseminated within the coordinated timeframes.

2.3.3 INITIATIVE CONSTRAINTS: Advanced automation capability and an improved **ATC** intervention capability are required.

2.4 INITIATIVE: Exploit GPS equipage to develop improved procedures to be utilized in transitioning to a full RNP oceanic airspace.

2.4.1 During the transition to a phase of "sole means," different **RNP** classifications may exist in oceanic airspace. Each regional oceanic airspace may have different separation standards based upon the **RNP** classification. **(Mid/Far-Term)**

2.4.2 TECHNICAL APPROACH: ATP-20, in conjunction with ATM and other **ATS** providers, should initiate tests and demonstrations to achieve maximum benefit from **GPS equipage** during this period and to standardize **ATC** procedures to be applied between **FIR/CTA's** based on regional **RNP** oceanic airspace classification and associated separation standards. Tests and demonstrations should include the availability of other satellite-based technology and **ATC** system integration of satellite and enhanced ground-based technology.

2.4.2.1 Benefits and/or costs: Airspace users benefit by cost savings due to increased system capacity and enhanced scheduling capability.

2.4.2.2 Develop a test plan and/or demonstration: The tests or demonstrations will be structured to achieve maximum benefit from **GPS equipage** through the development of standardized procedures between **FIR/CTA's.** Tests and/or demonstrations will be designed to:

- Evaluate the application of an advanced conflict probe function to aid the controller in conflict detection and resolution.
- Establish standardized **ATC** procedures between FIR's for providing **ATC** service in different **RNP** environment/s.

- Generate information for ATS providers to aid in the identification of resource requirements.

- Develop implementation strategies, plans, and time lines needed for implementation.

- Develop improved ATC intervention capability.

2.4.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20, in coordination with ATM, ICAO, and ATP-140, shall ensure the development of procedures which will supplement ICAO Document 4444 and FAA Order 7110.65 for use while conducting tests and demonstrations.

Based on the results of joint FAA and ICAO-sponsored tests or demonstrations, ATP-20 shall coordinate with ATP-140 to revise FAA Order 7110.65.

2.4.2.4 Training requirements for air traffic controllers: ATP-20 shall coordinate with ATZ to ensure the development of a training curriculum for applying new standards and procedures. ATZ shall ensure required dissemination and training are accomplished for revised ATC procedures described in FAA orders, manuals, and directives.

2.4.3 INITIATIVE CONSTRAINTS: Advanced automation and an improved ATC intervention capability needs to be developed and fielded.

2.5 INITIATIVE: Restructure special use airspace (SUA) to accommodate a GPS-based oceanic en route system:

2.5.1 Aircraft equipped with GPS are able to navigate more accurately within and around SUA. Because GPS-equipped flights are able to remain clear of the SUA, the protection buffer around the SUA can be reduced. **(Mid/Far-Term)**

2.5.2 TECHNICAL APPROACH: ATP-20, in conjunction with ATM-400, will determine what SUA will be affected by the implementation of direct and flexible GPS routings. ATP-20 and ATM, through coordination with appropriate DOD authorities, shall initiate a study based on GPS equipage to review SUA requirements and provide recommendations for modifications, if possible. The study shall also include the feasibility of establishing/modifying coordination procedures required to establish dynamic rerouting through SUA.

2.5.2.1 Determine benefits and/or costs: Airspace user benefits will be cost savings due to assignment of flights in airspace not currently available.

2.5.2.2 Develop a test plan and/or demonstration: ATP-20 and ATM, in conjunction with appropriate DOD authorities, will jointly develop study objectives. The study will be designed to determine feasibility of:

- Reducing size of SUA.

- Reducing buffer protecting SUA.
- Establishing/modifying coordination procedures.
- Identifying controller and pilot aids to enhance aircraft capabilities to navigate around SUA.

2.5.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20 shall ensure a review is conducted to identify all FAA orders, manuals, and directives which may require both editorial and procedural changes.

Based on the results of the study, and following coordination and agreement with DOD authorities, ATP-20 shall coordinate with ATM and ATP-140 to revise FAA Orders 7110.65 and 7610.4.

2.5.2.4 Training requirements for air traffic controllers: ATP-20 shall coordinate with ATZ to ensure the development of a training curriculum for implementing the new procedures. ATZ shall ensure required dissemination and training are accomplished for revised ATC procedures for operations in and around SUA described in FAA orders, manuals, and directives.

2.5.2.5 Final coordination requirements: ATP-20 shall ensure through ATP-140 and ATP-200 that all aeronautical charts and procedural and editorial changes are published and disseminated within the coordinated timeframes.

2.5.3 INITIATIVE CONSTRAINTS: One key constraint that must be dealt with is notification issues that are characteristic in the development of all SUA. A notification infrastructure will need to be in place to notify airspace users that a part of a dynamic SUA is active or has moved. This will require adaptation of the notice to airman (NOTAM) system and require an enhanced interface between the controlling agency (FAA facility) and the using agency. Dynamic airspace will also require expanded studies to consider the impact flexible movement of DOD activities has on shared use of airspace by differing weapon systems.

2.6 INITIATIVE: Establish an altitude stratum and track structure in oceanic airspace designated for GPS-equipped aircraft and update the tracks based on GPS positional information.

2.6.1 Based on air traffic demand during peak traffic periods in core traffic areas, it may be advantageous to establish tracks and/or an altitude stratum available to only GPS-equipped flights. As weather reports derived from airborne flights navigating the routes become available, the route can be amended to take advantage of changing conditions. **(Mid/Far-Term)**

2.6.2 TECHNICAL APPROACH: ATP-20, in coordination with ATR-330 and ATM-110, independently and in conjunction with ICAO, shall take steps to initiate experimentation, simulation, tests, and demonstrations to evaluate and determine the feasibility of an altitude stratum and/or track structure in oceanic airspace designated for GPS-equipped aircraft only.

This initiative is very similar to the one in paragraph 2.3 except special track and/or altitude strata for GPS-equipped aircraft would only be implemented during peak traffic periods. The following considerations, addressed in paragraph 2.3, need not be duplicated:

- ATC and pilot procedures.
- Monitoring criteria.
- Contingency procedures.

2.6.2.1 Benefits and/or costs: Users will benefit due to assignment of flights on, or closer to, the most optimum route and receive increased flight scheduling capability. The ATS providers benefit by providing improved services and increasing system capacity on user preferred routings.

2.6.2.2 Develop a test plan and/or demonstration: ATP-20, with ATR-300 and ATM-100, independently and in conjunction with ICAO, shall take steps to initiate experimentation, simulation, tests, and demonstrations to determine the feasibility of an altitude stratum and/or track structure in oceanic airspace designated for GPS-equipped aircraft only during peak traffic periods. These tests and demonstrations will be designed to:

- Establish altitude stratum for GPS-equipped aircraft only.
- Establish track structure for GPS-equipped aircraft only.
- Determine ATC and pilot procedures.
- Consider separation standards.
- Determine traffic management procedures.
- Determine process for implementing and amending routes based on "real time" weather and position data received from airborne GPS-equipped flights.
- Determine effect on non-GPS-equipped aircraft.
- Determine controller intervention requirements.

2.6.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20, in coordination with ATM, ICAO, and ATP-140, shall ensure the development of procedures which will supplement ICAO Documents 4444 and 7030 and FAA Order 7110.65 if tests and demonstrations are required.

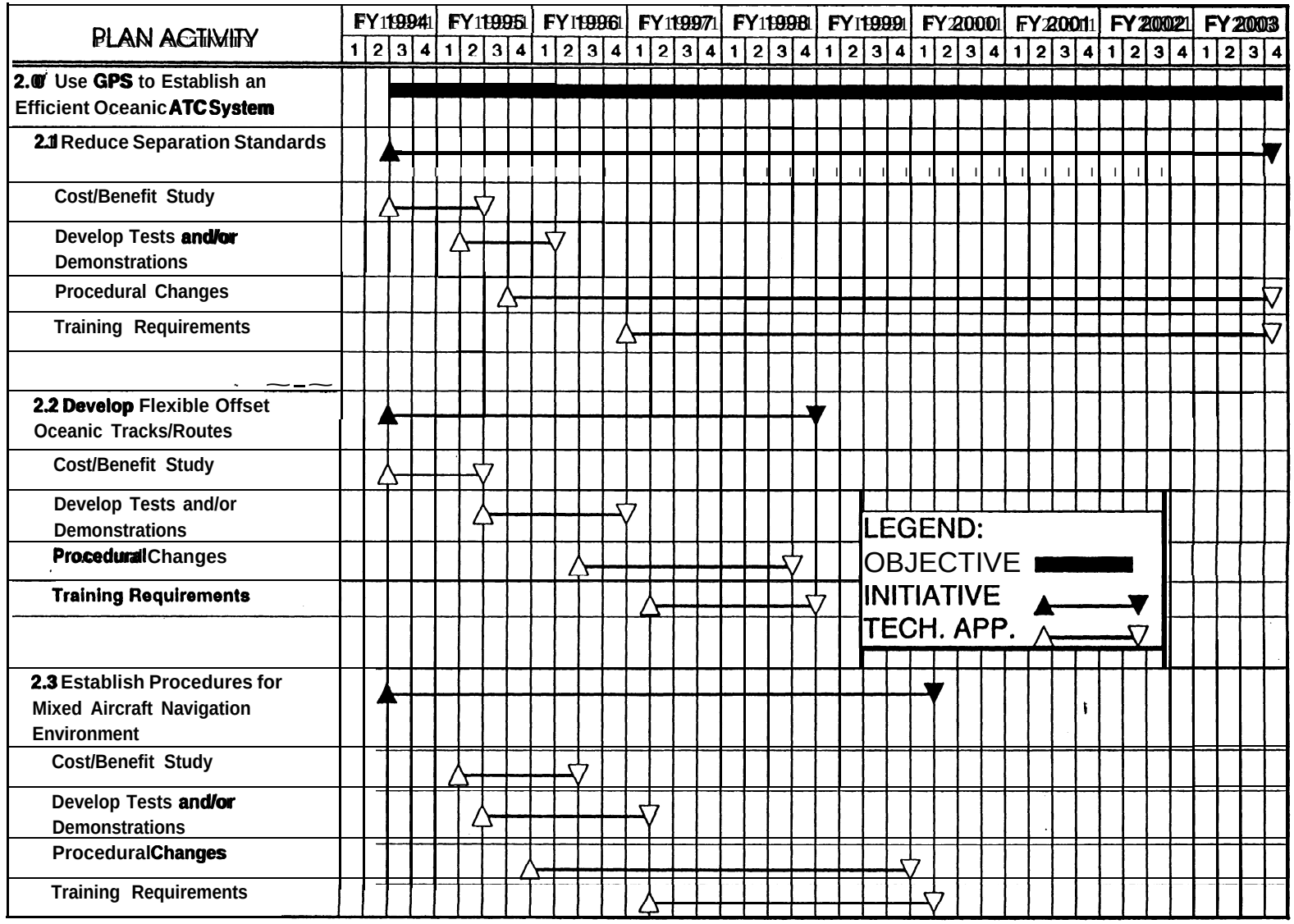
Based on the results of FAA or joint FAA- and ICAO-sponsored experiments, simulations, tests, or demonstrations, ATP-20 shall coordinate with ATP-140 to revise FAA Order 7110.65.

2.6.2.4 Training requirements for air traffic controllers: ATP-20 shall coordinate with ATZ to ensure the development of a training curriculum for implementing the new procedures. ATZ shall ensure required dissemination and training are accomplished for revised ATC procedures in FAA orders, manuals, and directives.

2.6.2.5 Final coordination requirements: ATP-20 shall ensure, through ATP-140 and ATP-200, that all aeronautical charts and procedural and editorial changes are published and disseminated within the coordinated time frames.

2.6.3 INITIATIVE CONSTRAINTS: Advanced automation and improved controller intervention capability are needed.

OBJECTIVE 2.0 - EXPLOIT THE USE OF GPS TO ESTABLISH A MORE EFFICIENT OCEANIC ATC SYSTEM



OBJECTIVE 2.0 - EXPLOIT THE USE OF GPS TO ESTABLISH A MORE EFFICIENT OCEANIC ATC SYSTEM

PLAN ACTIVITY	FY 1994				FY 1995				FY 1996				FY 1997				FY 1998				FY 1999				FY 2000				FY 2001				FY 2002				FY 2003			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
2.0 Oceanic (continued)																																								
2.4 Develop Standards to Transition to Full RNP																																								
Cost /Benefit Study																																								
Develop Tests and/or Demonstrations																																								
Procedural Changes																																								
Training Requirements																																								
2.5 Restructure Special Use Airspace																																								
Cost/Benefit Study																																								
Develop Tests and/or Demonstrations																																								
Procedural Changes																																								
Training Requirements																																								
2.6 Develop GPS Altitude and Track Structure																																								
Cost/Benefit Study																																								
Develop Tests and/or Demonstrations																																								
Procedural Changes																																								
Training Requirements																																								

3.0 EXPLOIT THE CAPABILITY OF GPS TO ESTABLISH A MORE EFFICIENT DOMESTIC EN ROUTE STRUCTURE.

The following initiatives outline a strategy to take advantage of the benefits GPS provides to improve the overall efficiency of the en route ATC system. While not specifically addressed in each initiative, plan implementers must also monitor and, if necessary, establish requirements to merge parallel advances in surveillance techniques to fully take advantage of GPS as it applies to the future CNS environment. Examples of these aspects of surveillance include ADS, pseudo-ADS, and the individual components of these systems such as data link, controller displays, communication systems, etc. Advances in AAS, Initial Sector Suite System (ISSS), ATN, and similar Air Traffic initiatives must also be considered. Without application of these collateral technologies, the benefits of the enhanced navigational accuracy of GPS cannot be optimized.

3.1 INITIATIVE: Restructure existing airway system to accommodate GPS-based direct routings.

3.1.1 Routings need to be developed that will allow GPS-equipped aircraft to operate on routes that are not dependent on ground-based NAVAID's. The present airway system is based on airways established between ground-based NAVAID's. In many instances, these airways are doglegged because of the geographical locations of NAVAID's. GPS routings are not limited by terrestrial navigational aids and can be direct to any point on the earth. **(Mid/Far-Term)**

3.1.2 TECHNICAL APPROACH: Air Traffic will develop an efficient GPS-based direct route structure. The steps that must be taken to realize this initiative include, but are not limited to, cost/benefit studies, coordination, test/demonstrations, data review, and procedural development, as described below.

3.1.2.1 Benefits and/or costs: ATP-20 shall ensure that an analysis is conducted determining what additional benefits or costs may be derived from this initiative other than those listed below:

- The user will realize cost savings resulting from less fuel consumption when flying the shorter, more direct routes.
- The service provider will realize a more efficient system when it is comprised of direct and/or random GPS routings.

3.1.2.2 Develop a test plan/demonstration: ATP-20 should ensure that coordination with AFS and AVN is accomplished to determine if criteria for GPS airway and route structure have been developed. ATP-20 shall ensure:

- ATM determines where the test routings would be most advantageous. Consideration must be given to traffic complexity and impact on the NAS.
- ATR determines that all air traffic requirements have been met before developing any GPS-direct routings test/demonstrations.

- All offices of primary interest establish timelines for training, publishing/printing, dissemination, and the effective dates of any new routings, procedures, or editorial changes to FAA orders, manuals, and directives.

- Interim procedures and recommended changes are developed to support the test/demonstration.

- The Fiji "proof of concept" tests are reviewed.

Regional Air Traffic Divisions, in coordination with ATP-20, shall develop test plans and select test sites within their respective regions. An evaluation shall be made of the equipment, resources, and financing that will be necessary to support the test/demonstration. This evaluation will be the responsibility of the regional Air Traffic Divisions.

Regional Air Traffic Divisions shall evaluate the collected results of the test/demonstration. The results will be used in developing air traffic procedures and routings that will be necessary to support this initiative.

3.1.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20 shall coordinate with ATP-100 and ATM-100/200/400 to ensure that all necessary ATC procedures and editorial changes to the FAA orders, manuals, and directives are developed using the data collected during the test/demonstrations.

3.1.2.4 Training requirements for air traffic controllers: ATP-20, through the offices of primary interest, will forward any procedural changes to ATZ-100.

If necessary, ATZ-100 shall develop and disseminate a training curriculum on the new procedures within the previously established timeframes. Training will be completed within previously established timeframes.

3.1.2.5 Final coordination requirements: ATP-20 shall ensure, through ATP-200, that all procedural and editorial changes have been published and disseminated within the coordinated timeframes.

3.1.3 INITIATIVE CONSTRAINTS: The user must be made aware that at IOC, GPS will not provide unlimited services. Predictable outages will occur in certain areas which could result in the requirement for other forms of navigational equipment. Also, the newly developed airway structure will cause environmental evaluations to be conducted.

3.2 INITIATIVE: Exploit the use of GPS to reduce separation standards in domestic en route airspace.

3.2.1 Nonradar separation standards are presently based on air- and ground-navigational-equipment accuracy. The accuracy of GPS exceeds that of any present ground-based en route navigational system in use and may allow the reduction of nonradar separation standards between GPS-equipped aircraft. Using the results of GPS-accuracy and GPS-integrity tests, an

analysis shall be made to determine what separation standards will be used in domestic en route airspace. Included in this analysis will be the possible reduction of minimum obstruction clearance altitudes (MOCA) and minimum en route altitudes (MEA) and the eventual elimination of minimum reception altitudes (MRA). **(Mid/Far-Term)**

3.2.2 TECHNICAL APPROACH: ATP-20 shall determine if the use of GPS can reduce separation standards for operations within domestic en route airspace. This will be accomplished through cost/benefit studies, coordination, test/demonstrations, and procedural development as indicated below.

3.2.2.1 Benefits and/or costs: ATP-20 shall ensure that an analysis is conducted to determine the benefits or costs that may be derived from this initiative which include, but are not limited to:

- Removing the user's requirement of carrying redundant navigational equipment aboard aircraft.
- Eliminating the user's need of cross-referencing equipment to make cockpit management easier.
- Increasing the service provider's capacity.

3.2.2.2 Develop a test plan/demonstration: ATP-20 shall ensure, through coordination with AFS/AVN, separation standards criteria for operations within GPS domestic en route airspace. This also includes criteria for required obstruction clearance (ROC). ATP-20 shall ensure that:

- ATM determines where the testing of GPS operations would be most advantageous. Consideration must be given to traffic complexity and impact on the NAS.
- Collision risk modeling is completed by AFS.
- Coordination with ATR is accomplished.
- Coordination with ATZ-100, ATP-100, and ATP-200 is accomplished in establishing timelines for training, publishing/printing, dissemination, and effective dates of any new ATC procedures or editorial changes to FAA orders, manuals, and directives.
- Interim procedures and recommended changes to be used in a test/ demonstration are developed.

Regional Air Traffic Divisions may, in coordination with ATP-20, be asked to develop test plans and select test sites within their regions to analyze GPS operations in domestic en route airspace.

Regional Air Traffic Divisions/ATP-20 shall analyze the results of the test/demonstrations. The collected data of the test/demonstrations will be used in

developing the necessary separation standards or the reduction of present separation standards which will allow GPS-equipped aircraft to operate in domestic en route airspace within the NAS.

3.2.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20, in coordination with **ATP-100,** shall ensure that all necessary **ATC** procedures and editorial changes to the FAA orders, manuals, and directives are developed to support this initiative.

3.2.2.4 Training requirements for air traffic controllers, ATP-20, through the offices of primary interest, shall forward any **ATC** procedural changes to **ATZ-100.** If necessary, **ATZ-100** shall develop and disseminate a training curriculum on the new procedures within the previously established timeframes. Training will be completed within established timeframes.

3.2.2.5 Final coordination requirements: ATP-20, through **ATP-200,** shall ensure that all procedural and editorial changes are published and disseminated within the coordinated timeframes.

3.2.3 INITIATIVE CONSTRAINTS: This initiative should allow more aircraft to enter the system which could exceed the system's current capacity. If the capacity is exceeded, additional personnel and equipment resources may be required.

3.3 INITIATIVE: Develop flexible alternate/parallel route capability and procedures that will relieve saturation on high density routes.

3.3.1 In the present day airway structure, predicated on ground-based navigational aids, high density areas become saturated causing extensive and costly delays. Flexible alternate/parallel routes and procedures need to be developed by Air Traffic now in anticipation of **GPS** being used as a primary system for **IFR** en route navigation. **(Mid-Term)**

3.3.2 TECHNICAL APPROACH: Flexible alternate/parallel routes, along with **ATC** procedures, will be developed by Air Traffic for identified high density areas to accommodate **GPS-equipped** aircraft. This initiative will be accomplished by cost/benefit studies, coordination within and outside of the FAA, establishing interim procedures, testing/demonstrating, gathering of data, and developing **ATC** procedures. The individual steps to accomplish this technical approach are listed below.

3.3.2.1 Benefits and/or costs: **ATP-20** shall ensure that an analysis is conducted to determine what additional benefits or costs may be derived from this initiative other than those listed below:

- An increase in system capacity and a significant reduction of delays.
- A cost savings to the user due to the reduction in system delays.

3.3.2.2 Develop a test plan/demonstration: ATP-20, through coordination with **AFS** and **AVN,** shall determine criteria for **GPS** airways, route structures, and **ROC. ATP-20** shall ensure:

- ATM determines where test routings would be most advantageous. Consideration must be given to traffic complexity and impact on the NAS.
- Coordination with ATR is accomplished.
- Coordination with ATZ-100, ATP-200, and ATP-100 is accomplished in determining timelines for training, publishing/printing, dissemination and the effective dates of any new routings, ATC procedures, or editorial changes to FAA orders, manuals, and directives.
- Interim procedures and recommended changes are developed to be used in any test/demonstrations.
- The Fiji "proof of concept" tests in route structure are reviewed to determine applicability to this initiative.

Regional Air Traffic Divisions, in coordination with ATP-20, may be requested to develop test plans and select test sites within their regions. These tests will include developing flexible alternate/parallel routings and any ATC procedures necessary to support this initiative. An evaluation will be made of the equipment, resources, and financing necessary to support the test/demonstration.

Regional Air Traffic Divisions, in coordination with ATP-20, shall evaluate the collected data of the test/demonstrations. The results of the tests will be used in developing flexible alternate/parallel routings and ATC procedures to support this initiative.

3.3.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20 shall ensure, through ATP-100, ATM-100, and ATM-200, that all necessary ATC procedures and editorial changes to the FAA orders, manuals, and directives are developed to support this initiative.

Regional Air Traffic Divisions shall develop flexible alternate/parallel routings for their particular regions using the results of the tests and prescribed GPS criteria for establishing routings.

3.3.2.4 Training requirements for air traffic controllers: ATP-20, through ATP-100, ATM-100, and ATM-200, will forward any procedural changes to ATZ-100. If necessary, ATZ-100 shall develop and disseminate a training curriculum on the new ATC procedures within the previously established timeframes. Training will be completed prior to implementation.

3.3.2.5 Final coordination requirements: ATP-20, through the offices of primary interest, shall ensure all procedural and editorial changes are published and disseminated within the coordinated timeframes.

3.3.3 INITIATIVE CONSTRAINTS: Allowing additional aircraft into the system may exceed system and sector capacity which would require additional resources.

3.4 INITIATIVE: Restructure SUA to accommodate a GPS-based en route system.

3.4.1 The advent of a GPS-based NAS, where the current system of VOR/DME-based "victor" airways and jet routes is replaced by more direct and flexible GPS-based routes, will have an impact on the current SUA structure. GPS-based routes have the potential to enhance flexibility, to the extent that routes will be more direct and can be adjusted based on current conditions; for example, adverse weather, en route winds, flow restrictions, etc. This affords the opportunity for creation of dynamic airspace, primarily military operations areas (MOA) and air traffic controlled assigned airspace (ATCAA) which could be moved away from the en route flow. Military aircraft would no longer use very high frequency omnidirectional tactical air navigation (VORTAC) and tactical air navigation (TACAN) for area orientation but would use GPS to provide orientation and accurate area identification. The potential benefits would include better airspace utilization, less spill-outs, lower frequency of airspace denials, and more efficient and fuel saving routes for en route traffic. Similar benefits, although not as substantial, will be possible with restricted areas, warning areas, and military training routes that are dependent on the nature of the military activity being conducted. The advantages, GPS offers SUA management should also be merged into development of new SUA management tools, to include the DOD Military Airspace Management System (MAMS) currently under development. The necessity of automated near-real-time airspace management tools like MAMS will be imperative to maximize the benefits offered by GPS within SUA. **(Mid/Far-Term)**

3.4.2 TECHNICAL APPROACH: A significant portion of SUA could affect the future optimization of a GPS-based airspace structure in the NAS. The FAA and the DOD must conduct a joint analysis of all SUA to determine where SUA will adversely affect a GPS-based route structure and how to reduce or otherwise minimize the effect. This technical approach will be accomplished through environmental analyses, coordination, and procedural development listed below.

3.4.2.1 Benefits and/or costs: ATP-20 shall ensure that an analysis is conducted in concert with ATM and the DOD to determine and quantify any benefits for the user and the service provider.

3.4.2.2 Develop a test plan/demonstration: ATP-20, ATM, DOD, and the regional Air Traffic Divisions shall determine, through an analysis, the impact to SUA by the implementation of flexible, direct, and alternate/parallel routings. This effort shall be coordinated with all locally affected ATC facilities, military units, local FAA representatives/liaison officers where assigned, and the air route traffic control center (ARTCC) having jurisdiction over the affected airspace.

Regional Air Traffic Divisions shall negotiate all proposals of change to SUA as directed in accordance with FAA 7400.2D.

3.4.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: If necessary, ATP-20 shall ensure, through ATP-100, that any ATC procedural development is accomplished.

3.4.2.4 Training requirements for air traffic controllers: ATP-20, through ATP-100, will forward all recommended procedures to ATZ-100. If necessary,

ATZ-100 will develop and disseminate a training curriculum on the new ATC procedures within the previously established time frames. Training will follow at a rate commensurate with procedure implementation.

3.4.2.5 Final coordination requirements: ATP-20 shall ensure that all coordination is accomplished to allow the implementation of this initiative consistent with the milestones and requirements stipulated within this plan.

3.4.3 INITIATIVE CONSTRAINTS: Two key constraints are notification and environmental issues characteristic in the development of all SUA. A notification infrastructure will need to be in place to notify airspace users that a piece of dynamic SUA is active or has moved. This will require modification of the NOTAM system and will also require an enhanced interface between the controlling and using agency. Dynamic airspace will also require expanded environmental studies to consider the impact that flexible movement of DOD activities has on the environment combined with the impact of shared use of airspace by differing weapon systems.

3.5 INITIATIVE: Establish an altitude stratum in domestic airspace designated for GPS-equipped aircraft.

3.5.1 Designating altitudes that only GPS-equipped aircraft may operate within will establish a restricted environment in which to conduct evaluations of GPS accuracy. Testing of newly developed ATC procedures can be accomplished between GPS-equipped aircraft while allowing these aircraft early GPS use. The early usage of GPS should accelerate voluntary equipage and lessen controller workload by segregating GPS-equipped aircraft in the initial stage. **(Mid-Term)**

3.5.2 TECHNICAL APPROACH: Designate an altitude stratum that will allow GPS-equipped aircraft the benefit to operate in an environment providing the most direct routings without interference from non-GPS-equipped aircraft. This altitude stratum will allow the service provider the opportunity to test newly developed GPS ATC procedures. To accomplish this initiative requires that consideration be taken in the areas of cost/benefit analysis, coordination, test/demonstrations, and procedural development. These are but a few of the steps necessary to complete this initiative. The complete technical approach is listed below.

3.5.2.1 Benefits and/or costs: ATP-20 shall ensure that an analysis is conducted determining what additional benefits or costs may be derived from this initiative other than those listed below:

- The ability of the service provider to conduct procedural testing within a sterile environment.
- Early use for appropriately equipped aircraft.
- The user being allowed to operate on routes not made up of ground-based navigational aids which limit navigational ability.

- Flights operating on more direct routes saving time, fuel, and operating expenses.

3.5.2.2 Develop a test plan/demonstration: ATP-20 shall ensure that coordination with AFS and AVN is accomplished in determining criteria for GPS-separation standards to include criteria for ROC. ATP-20 shall ensure:

- Coordination with ATM is accomplished to determine what altitude stratum (high, low, or both) would be most advantageous for test/demonstrations of GPS-separation standards. Consideration must be given to traffic complexity and impact on the NAS.

- Coordination with ATR is met.

- Coordination with ATP-100, ATP-200, and ATZ-100 is accomplished in determining timelines for training, publishing/printing, dissemination, and the effective dates of any new ATC procedures, or editorial changes to FAA orders, manuals, and directives.

- Interim procedures and recommended changes to FAA orders, manuals, and directives are developed that may be used in any test/demonstrations.

- The Fiji "proof of concept" tests results are reviewed to determine if they can be applied to this initiative.

Regional Air Traffic Divisions, in coordination with ATP-20, may be required to develop test plans, select test sites, and altitude stratums within their regions. These tests will include the application of any recommended GPS-separation standards that may have been developed in previous initiatives.

Regional Air Traffic Divisions shall conduct an evaluation of equipment, resources, and financing to support the test/demonstration.

Regional Air Traffic Divisions, in coordination with ATP-20, shall evaluate the collected data of the test/demonstrations. The results of the tests will be used in developing the necessary ATC procedures to be used to support this and possibly other initiatives.

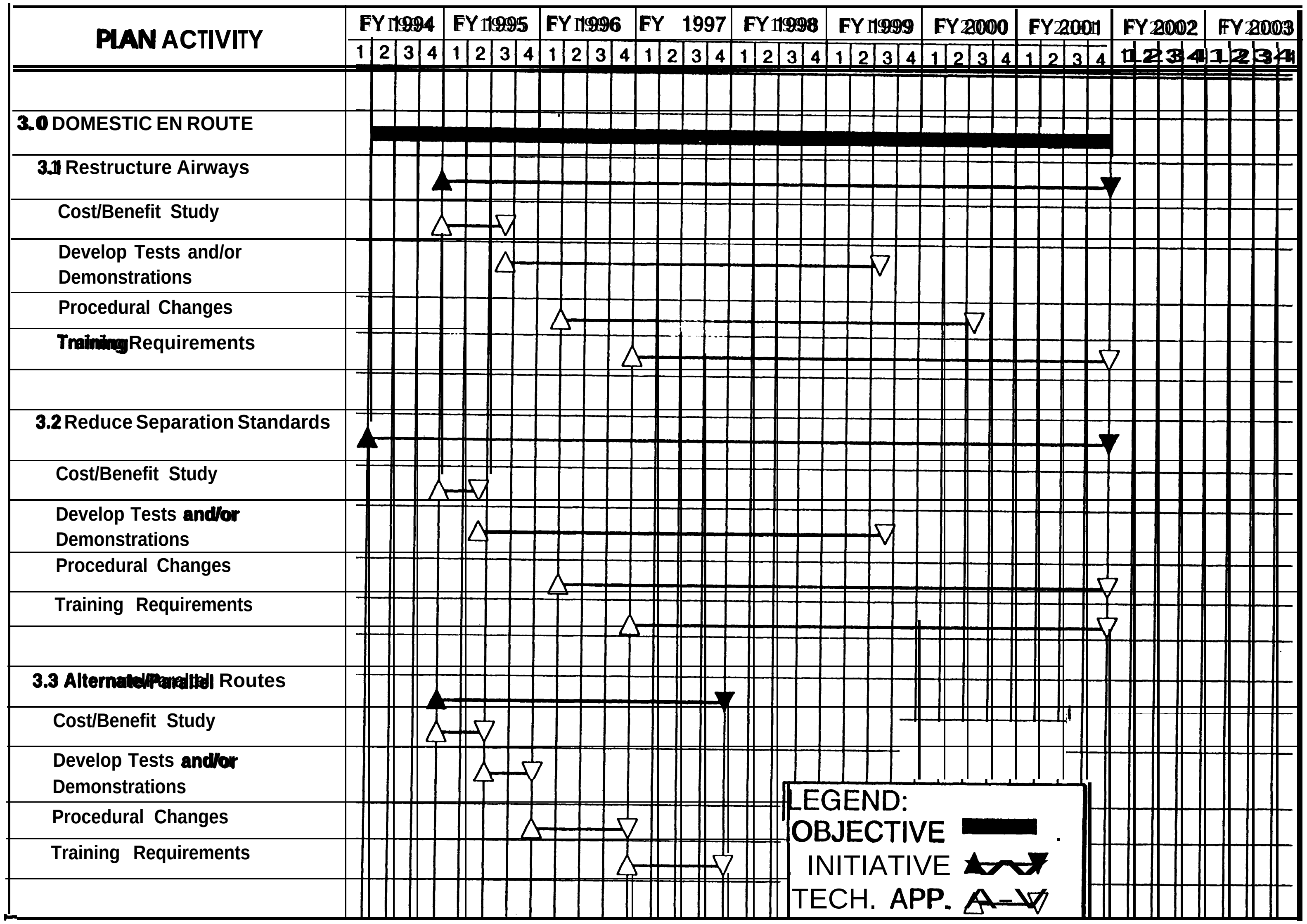
3.5.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20 shall ensure, through ATP-100, that all necessary ATC procedures and editorial changes to the FAA orders, manuals, and directives are developed to support this initiative.

3.5.2.4 Training requirements for air traffic controllers: ATP-20, in coordination with the offices of primary interest, will forward all recommended procedures to ATZ-100. If necessary, ATZ-100 will develop and disseminate a training curriculum on the new ATC procedures within the previously established timeframes. Training will be completed within established timeframes.

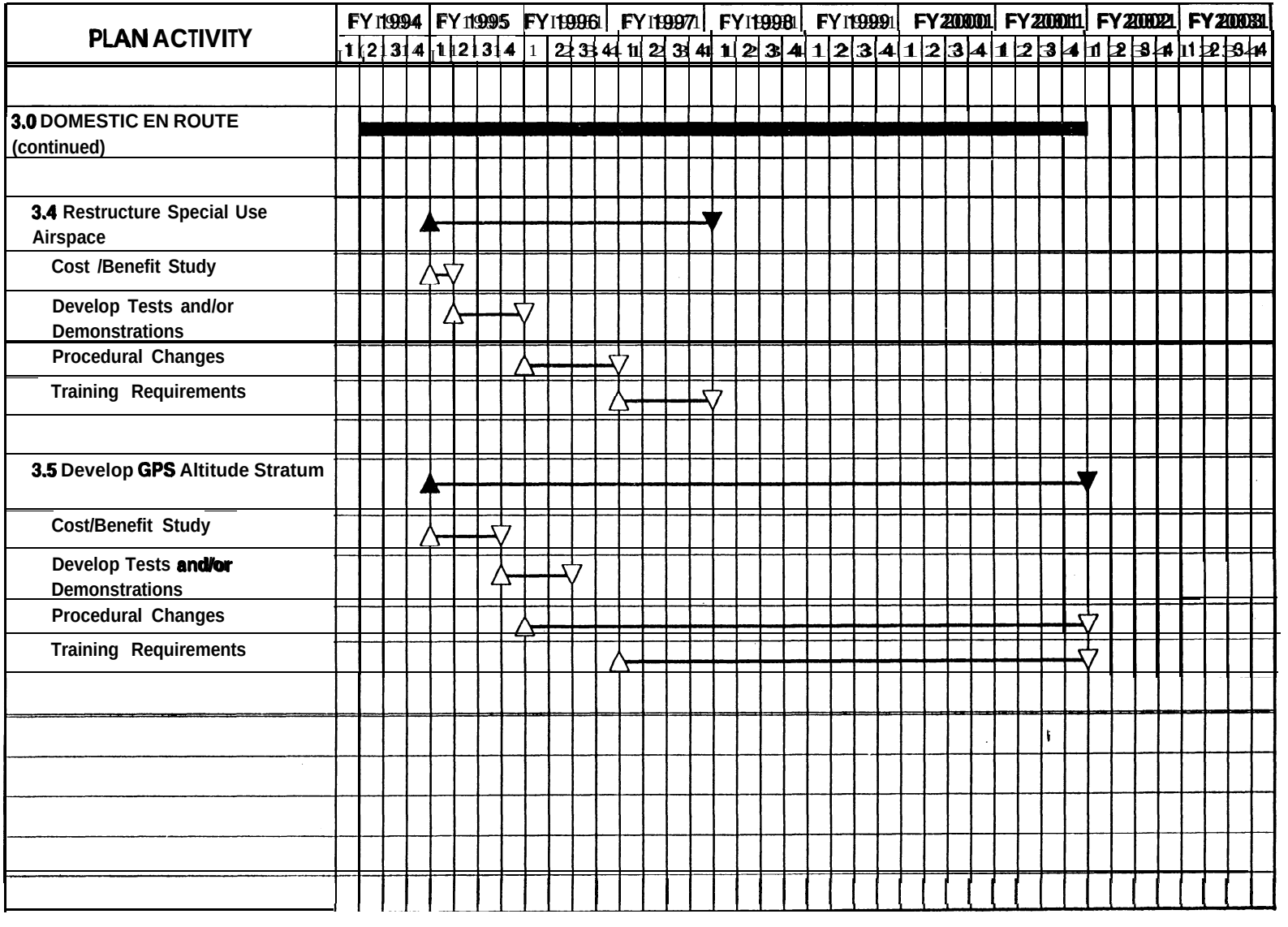
3.5.2.5 Final **coordination requirements: ATP-20** shall ensure, through **ATP-200,** that all procedural and editorial changes are published and disseminated within the coordinated timeframes.

3.5.3 INITIATIVE CONSTRAINTS: None anticipated.

OBJECTIVE 3.0 - EXPLOIT THE CAPABILITY OF GPS TO ESTABLISH A MORE EFFICIENT EN ROUTE STRUCTURE



OBJECTIVE 3.0 - EXPLOIT THE CAPABILITY OF GPS TO ESTABLISH A MORE EFFICIENT EN ROUTE STRUCTURE



4.0 EXPLOIT THE USE OF GPS FOR TERMINAL AIR TRAFFIC CONTROL OPERATIONS.

The following initiatives outline a strategy to take advantage of the benefits GPS provides to improve the overall efficiency of the terminal ATC system. While not specifically addressed in each initiative, plan implementers must also monitor and, if necessary, establish requirements to merge parallel advances in surveillance techniques to fully take advantage of GPS as it applies to the future CNS environment. Examples of these aspects of surveillance include ADS, pseudo-ADS, and the individual components of these systems, such as data link, controller displays, communication systems, etc. Advances in AAS, ISSS, ATN, and similar Air Traffic initiatives must also be considered. Without application of these collateral technologies, the benefits of the enhanced navigational accuracy of GPS cannot be optimized.

4.1 INITIATIVE: Establish a GPS-based terminal route structure to include IFR, VFR, and SVFR criteria.

4.1.1 The increased navigational accuracy of GPS opens new avenues for more efficient management of the terminal airspace through the creation of GPS-based direct terminal routes. These direct routes, both VFR and IFR, will provide user aircraft the ability to transit through and around terminal airspace using published or randomly assigned point-to-point and airport-to-airport routings via onboard aircraft navigation. The inherent flexibility of GPS will provide easier VFR/SVFR user access while not disrupting the IFR traffic flow. In addition, assigned routings will reduce vector requirements and not be dependent on placement of ground-based NAVAID's. **(Mid/Far-Term)**

4.1.2 TECHNICAL APPROACH: "Proof of concept" testing conducted in Fiji validated the direct routing concepts that can be derived from a GPS-based terminal airspace. Based on those assumptions, terminal facilities and en route facilities with terminal responsibilities, under the direction of regional Air Traffic Divisions, will perform local airspace analyses to determine where the specific facilities can optimize airspace design to take advantage of the enhanced capabilities of GPS.

4.1.2.1 Benefits and/or costs: Potential benefits of developing a GPS-based terminal route structure include, but are not limited to:

- Reducing or eliminating vector requirements and overcoming the inherent limitations of ground-based NAVAID's which currently define the route structure.
- Increasing use of secondary airports.
- Enhancing weather avoidance capability .
- Special use purposes, such as more efficient ingress/egress routes to military training areas and routes, integrating special requirements of law enforcement, and clear identification of temporary flight restriction areas.
- Easier and more accurate identification of controlled airspace by the users.

4.1.2.2 Develop a test plan/demonstration: A test plan shall be developed by ATP-20, in coordination with ATP, ATM, ATR, regions, and other services within FAA (AFS, AVN, AAF, etc.). ATP-20 will exercise managerial oversight to ensure that the plan is properly coordinated and that the plan identifies required staffing, appropriate test/demonstration procedures, and locations. The test plan should include but not be limited to the following:

- A cost/benefit analysis will be performed by ATP-20 to validate the anticipated benefits and estimate the potential costs, considering not only monetary and personnel resources, but operational penalties/efficiency as well.

- The next actions in this initiative will be comprised of airspace analyses used primarily to determine the optimum route structure within the terminal airspace. The Fiji "proof of concept" test results may be used as a modeling tool for further testing of candidate airspace structures. FAA regions will direct their terminal facilities to perform airspace analyses to determine where GPS-based terminal routes could improve the efficiencies of traffic flow in and around their specific terminal areas. Regional Air Traffic Divisions will then provide regional implementation plans for establishment of a GPS terminal route structure for locations within their regions.

- Implementation of terminal routes based on GPS navigation will occur during the "transition" phase at an incremental rate consistent with user equipage and airspace redesign. Consideration must be given to the use of GPS-enhanced FMS and future domestic application of ADS.

- Procedural changes and development of training curriculum for the controller force will be an ongoing process dependent upon the rate of user equipage and the commensurate rate of conversion to a GPS-based airspace.

4.1.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: Using the results of the test/demonstrations, ATP-20 will ensure changes to all FAA orders, manuals, and directives are forwarded to ATP-100. In addition, these changes will be forwarded to ATP-200 for publication with sufficient lead time to meet planned navigational and equipment implementations. This will be accomplished in an incremental and evolutionary fashion consistent with advances in aircraft equipage, as well as ATC facility and procedural enhancements.

4.1.2.4 Training requirements for air traffic controllers: ATP-20 will ensure coordination with ATZ to develop those recommended changes to procedures and directives resulting from these tests in sufficient time to develop and provide the required training directives and curriculum to the appropriate regional offices, field sites, and the FAA Academy.

4.1.2.5 Final Coordination Requirements: ATP-20 will maintain contact with all tasked offices and provide overall managerial oversight to ensure the task milestones in this initiative are met. Continuous coordination with ATP-120 shall be maintained to ensure all aspects of the terminal ATC environment are addressed.

4.1.3 INITIATIVE CONSTRAINTS: The flexible aspects of GPS routings in the terminal environment will expand controlled airspace, both horizontally and vertically. The potentially extensive environmental impact studies caused by creation of routes over areas not previously subject to significant air traffic must be addressed in the airspace analyses. The anticipated increases in airspace capacity and benefits from the establishment of GPS terminal routes cannot be realized without parallel efforts to increase airport capacity through advances in airport surface surveillance criteria and similar capacity enhancements stipulated in this plan.

4.2 INITIATIVE: Use GPS capability to reduce terminal separation standards.

4.2.1 GPS offers the potential for reduced separation standards within the terminal environment resulting primarily from the reduction in size of the required obstacle clearance areas and protected airspace due to the increased accuracy of the GPS navigational systems. Reduction of separation standards will be an ongoing incremental process continuing through completion of the development of a GPS-based NAS. Initial efforts should capitalize on current FMS/GPS technology with immediate investigation into such areas as reduction of lateral separation for simultaneous or parallel approaches with follow-on studies involving advances in surveillance techniques. It is anticipated that separation may be reduced to as little as 2 miles-in-trail on final. Separation for parallel operations may be limited only to wake turbulence considerations because the limitations imposed by instrument landing system (ILS) signal blockage and ILS critical areas will be eliminated. GPS will require augmentation to ensure integrity and accuracy during precision approaches. Differential correction data will be required. Additional enhancements that must be tested are ADS or pseudo-ADS and a data link using satellite communications (SATCOM), Mode S, and/or very high frequency (VHF) radio frequencies. **(Mid/Far-Term)**

4.2.2 TECHNICAL APPROACH: Development of GPS-based reduced separation standards will be an incremental and continual process with relatively few reductions anticipated through the near- and mid-term phases of GPS implementation. This will be due to the anticipated mix of old and new equipage on user aircraft and the requirement for LDGPS. As advances in collateral technologies occur, it should be anticipated that the rate of user conversion to GPS navigation will steadily increase with corresponding increase in adoption of reduced separation standards. Extensive proof of concept simulation, testing, and substantial operational demonstrations will be required prior to implementation. Additionally, ATP-20 shall monitor the progress and results of all GPS precision approach testing. During this testing, a pseudo-ADS or ADS with data link should be explored to possibly replace the current high update radar required for simultaneous precision approaches to parallel runways separated by 3,400 to 4,300 feet. Separation standards of less than 3,400 feet between parallel runways must also be explored.

4.2.2.1 Benefits and/or costs: ATP-20 will ensure an initial feasibility study is conducted which will be used to forecast possible reductions in separation as user equipage progresses toward GPS sole-means implementation. It is anticipated that benefits will be realized by both the user and the service provider. These benefits include, but are not limited to:

- The ability to significantly increase system capacity and reduce delays.

- User cost savings due to increased system capacity and the reduction of delays and fuel savings through direct routings.

- The availability of precision approaches to airports/runways previously inaccessible will open numerous avenues to both controller and pilot, such as:

  - Additional cities could receive regularly scheduled air service that is not weather dependent.

  - Other airports available during aircraft emergencies.

  - Closer alternate airports would require less holding and reduced fuel load.

  - Elimination of expensive ground-based ILS/MLS equipment.

4.2.2.2 Develop a test plan/demonstration: Incremental increases in user equipage, combined with advances in collateral technology, justify consideration of a phased implementation. Testing will be phased in in order to exploit current technology to achieve commensurate reductions in separation. Phase points to begin study on further reductions in separation will be determined by ATP-20 following significant advances in collateral technology in avionics such as differential techniques and ADS when combined with advances in ATC automation such as workstations, displays, etc. Actions will include, but not be limited to:

- Ensuring ATP, ATM, and ATR determine the optimum methodology and test locations to be used for "proof of concept" tests and further operational tests.

- Developing the appropriate test plans, evaluating criteria, and determining test site locations. Since maximum benefit will be realized in a GPS-based airspace, FAA must take advantage of the results from "proof of concept" tests conducted in Fiji and create test scenarios for reduced separation at the selected locations.

- Consultating with ATM and the regional Air Traffic Divisions to evaluate the results of the tests and demonstrations to finalize time lines for implementation and/or further testing.

- Monitoring results of the following tests should be closely monitored:

  - Manchester, New Hampshire

  - Wittman Airport, Oskosh, Wisconsin

  - Dallas-Fort Worth, Texas, trials

4.2.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: Using the results of the test/demonstrations, ATP-100 will develop all necessary ATC procedures and editorial changes to the appropriate FAA

orders, manuals, and directives. ATP-200 will ensure publication of all required changes to all FAA orders, manuals, and directives.

4.2.2.4 Training requirements for air traffic controllers: ATP-20 will provide ATZ with those recommended changes to procedures and directives resulting from these tests in sufficient time for ATZ to develop and provide the required training directives and curriculum to the appropriate regional offices, field sites, and the FAA Academy.

4.2.2.5 Final coordination requirements: ATP-20 will implement this initiative in accordance with the predetermined dates and established milestones. It is anticipated that the implementation of this initiative will be an incremental and ongoing process with reduction of separation standards increasing at a rate commensurate with the evolution to a GPS-based airspace.

4.2.3 INITIATIVE **CONSTRAINTS:** implementation of this initiative will be constrained primarily by the rate of aircraft equipage and the rate at which GPS-based airspace is established. Separation reductions can only be maximized with all participants GPS-equipped.

4.3 INITIATIVE: Use GPS to identify, track, and control aircraft and vehicles on an airport surface to an accuracy of 1 to 3 meters.

4.3.1 GPS will improve safety and enhance air traffic operations by providing accurate position data to an integrated package of surface surveillance systems and enhanced automation capabilities. These GPS-enhanced systems will provide air traffic control the ability to separate vehicles and aircraft on movement areas during periods of low visibility. Potentially, aircraft electronic displays can show assigned taxi route overlays and position of other aircraft on the airport surface. Controllers can also have displays from which to actively manage traffic on the airport surface. The aircraft position, as well as the locations of other aircraft and vehicles, will be established by GPS. Mode-S and the GNSS data link will transmit aircraft identity and position to the tower through an ADS scheme. **(Near/Mid-Term)**

4.3.2 TECHNICAL APPROACH: This initiative should be accomplished through study of results obtained thus far from development, testing, and operations currently underway and forecast in the area of airport surface detection such as the Manchester, New Hampshire, project. GPS position data should be a prime tool in further enhancement of the FAA runway incursion program initiatives. Future studies should piggyback on programs such as the airport movement and surveillance system (AMASS), airport surface detection equipment (ASDE), and airport surveillance traffic automation (ASTA), with increased emphasis on extension of the ADS/Mode-S data link concept to the terminal environment.

4.3.2.1 Benefits and/or costs for both user and service provider: The successful accomplishment of this initiative will require investment by both user and provider in both developmental and hardware costs for CNS-related equipment and services. The benefits anticipated in the form of safety and capacity enhancements warrant completion of comprehensive cost/benefit studies to determine how to maximize the benefits GPS can offer airport surface movement. Benefits will include but not be limited to:

- Provide air traffic control the ability to separate vehicles and aircraft on movement areas during periods of low visibility
- Reduce the probability of runway incursions.
- Establish a departure sequence by expediting ground movement operations.
- Monitor compliance with assigned taxi routes.

4.3.2.2 Develop a test plan/demonstration: ATP-20, in coordination with **ATP,** ATM, **ATR, AFS,** and the regions, will ensure the development of test plans and evaluation of criteria and determine test locations, if required. **ATP-20** shall ensure that this initiative is fully coordinated with the responsible FAA offices and appropriate agencies and user groups outside of the FAA. Development of test plans should consider the following:

- The test plans should draw on the results and benefits derived from previous testing and development of collateral airport surface movement enhancement programs such as AMASS, **ASTA, ASDE-3,** etc.
- It is recommended that the use of **GPS** derived position information be studied in future test efforts to exploit Mode-S and ADS/real-time data link concepts on the airport surface in order to overcome radar-based limitations currently experienced by **ASDE.**

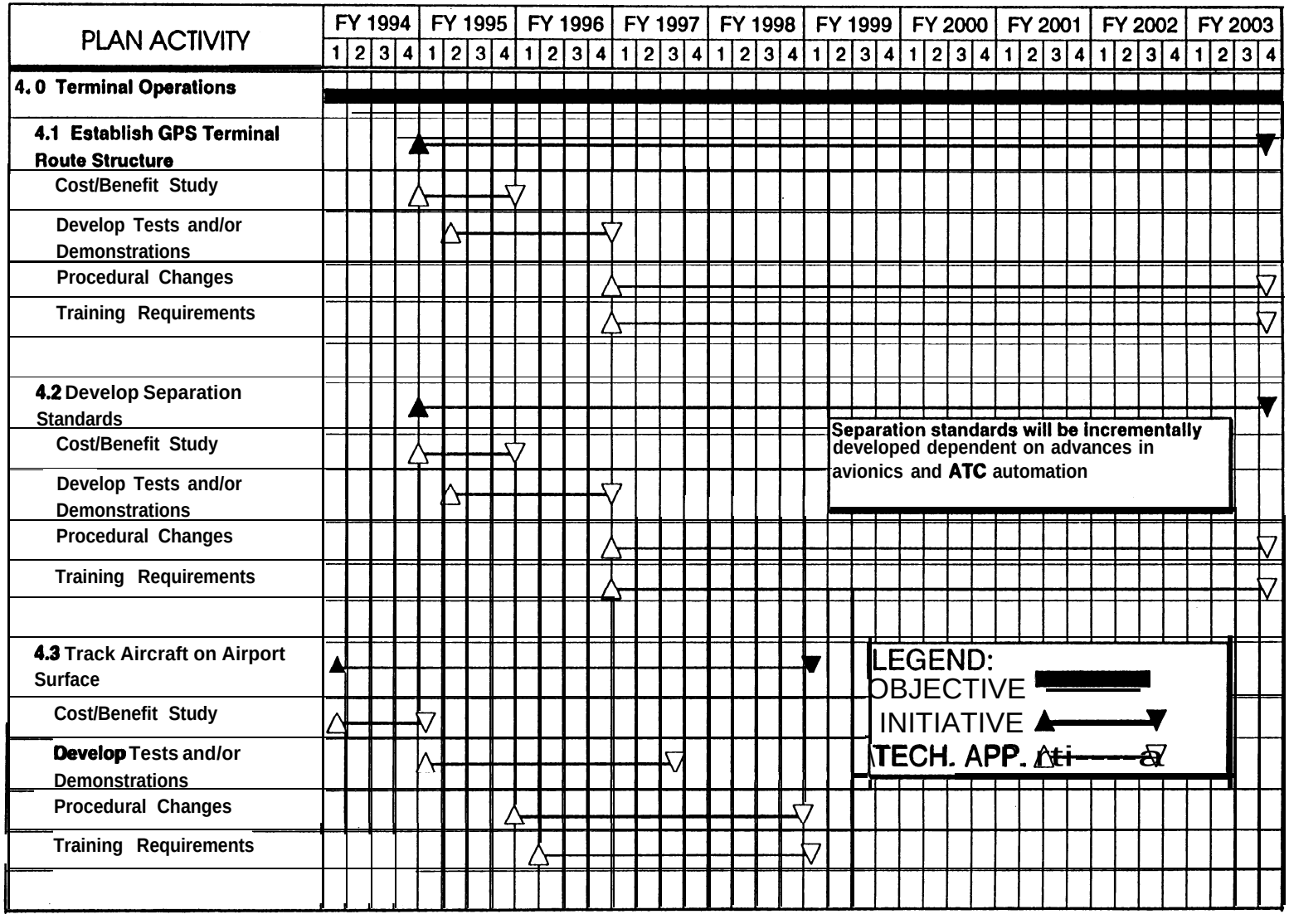
4.3.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: Using the results of the test/demonstrations, **ATP-20** will ensure that all necessary **ATC** procedures and recommended editorial changes to the appropriate FAA orders, manuals, and directives are identified. This will be accomplished in an incremental and evolutionary fashion consistent with advances in aircraft **equipage** and **ATC** facility enhancements.

4.3.2.4 Training requirements for air traffic controllers: ATP-20 will ensure coordination with **ATZ** to develop those recommended changes to procedures and directives resulting from these tests in sufficient time to develop and provide the required training directives and curriculum to the appropriate regional offices, field sites, and the FAA Academy.

4.3.2.5 Final coordination requirements: ATP-20 will maintain contact with all tasked offices and provide overall managerial oversight to ensure the task milestones in this initiative are met.

4.3.3 INITIATIVE CONSTRAINTS: Completion of this initiative is dependent on the rate of user and facility equipage. A key element which must be in place prior to **GPS** usage will be the fielding of local differential reference stations. These facilities are essential to achieve the accuracies required for this implementation.

OBJECTIVE 4.0 - EXPLOIT THE USE OF GPS FOR TERMINAL AIR TRAFFIC CONTROL OPERATIONS



5.0 USE THE CAPABILITIES OF GPS TO PROVIDE ENHANCED AND MORE PRECISE AIR TRAFFIC SERVICES FOR ROTORCRAFT OPERATIONS.

The following initiatives outline a strategy to take advantage of the benefits GPS provides to improve the overall efficiency of rotorcraft operations. While not specifically addressed in each initiative, plan implementers must also monitor and, if necessary, establish requirements to merge parallel advances in surveillance techniques to fully take advantage of GPS as it applies to the future CNS environment. Examples of these aspects of surveillance include ADS, pseudo-ADS, and the individual components of these systems such as data link, controller displays, communication systems, etc. Advances in AAS, ISSS, ATN, and similar air traffic initiatives must also be considered. Without application of these collateral technologies, the benefits of the enhanced navigational accuracy of GPS cannot be optimized.

5.1 INITIATIVE: Establish a direct routing capability for rotorcraft.

5.1.1 Rotorcraft operate in an ATC environment that was designed to support fixed-wing aircraft. GPS technology will allow rotorcraft to maximize the use of direct, efficient routing without adversely affecting fixed-wing traffic and ATC. **(Near- through Far-Term)**

5.1.2 TECHNICAL APPROACH: This technical approach develops direct rotorcraft routes and interim procedures that will be tested and validated to effect new ATC procedures. It integrates the focus of two other initiatives within this plan concerning domestic en route development (paragraph 3.1) and VFR/SVFR route criteria (paragraph 4.1). This approach also complements two Rotorcraft Master Plan projects concerning transition routes, procedures, charting and structures, plus it melds data from DOT/FAA/RD-90/18 and DOT/FAA/RD-90/19 pertinent to rotorcraft ATC route standards in order to reduce duplication of effort and ensure that all facets of the initiative are considered.

5.1.2.1 Benefits and/or costs: ATP-20, in conjunction with ARD-30, shall ensure that a detailed benefit/cost analysis is undertaken to establish the cost effectiveness of this initiative. The following three reports developed under the auspices of ARD-30 should be the basis of the analysis:

- Rotorcraft Low Altitude CNS Benefit/Cost Analysis: Operations Data (DOT/FAA/DS-89/9).
- Rotorcraft Low Altitude IFR Benefit/Cost Analysis: Operations Analysis (DOT/FAA/DS-89/10).
- Rotorcraft Low Altitude IFR Benefit/Cost Analysis: Recommendations and Conclusions (DOT/FAA/DS-89/11).

5.1.2.2 Development of a test plan/demonstration: The test plan shall be developed in coordination with ARD-30 and various services in Air Traffic, plus other organizations as required (AAF, AFS, AAP, etc..). ATP-20 will ensure that the jointly developed plan identifies necessary equipment, staffing, interim procedures, and test/demonstration site(s). The plan should include, but not be limited to the following efforts:

- Overlay and/or modify the Northeast corridor area navigation (RNAV) route structure to support the transition to GPS. (Near/Mid-Term)

- Establish precise VFR/SVFR routes between upgraded Northeast corridor RNAV point-in-space approaches and attendant airports or heliports to include those for hospitals or other emergency facilities, such as police headquarters. These routes will greatly aid itinerant users, reduce the chances of any user becoming disoriented, and facilitate the flow of traffic within the terminal area. (Near/Mid-Term)

- Establish VFR/SVFR routes from airports with conventional approaches to hospital heliports with no IFR capability in order to enhance emergency medical service/helicopter (EMS/H) capabilities. (Near-Term)

- Develop discrete routes between hospitals with GPS-approach capabilities to support interhospital transfers of stabilized patients which account for approximately 75-80 percent of EMS/H missions. (Mid-Term)

- Establish follow-on routes and procedures for:

  - Atlanta 1996 Olympic support (Mid-Term)
  - The Los Angeles environs (Mid/Far-Term)
  - Gulf of Mexico offshore oil complexes (Mid/Far-Term)
  - The Texas Golden Triangle (Dallas-Austin-Houston) (Far-Term)

- Ensure incorporation of common procedures and standards from ARD-30's vertical flight terminal area procedures (VERTAPS) project.

- Ensure that this initiative is fully coordinated with other rotorcraft initiatives that will use the Northeast corridor as a test bed.

- Ensure Air Traffic and the regions evaluate the collective test results.

5.1.2.3 Develop necessary ATC procedural and/or editorial changes required to support **the initiative: ATP-20,** in coordination with **ATP-100,** shall ensure the development of **ATC** procedures and make changes to FAA documents in concert with test results and approved recommendations.

5.1.2.4 Training requirements for air traffic **controllers: ATP-20** shall ensure, through **ATZ,** the development of any requisite training as procedural and/or document changes warrant.

5.1.2.5 Final **coordination requirements: ATP-20** shall coordinate with **ATP-200** to ensure all procedural and editorial changes have been published and disseminated in accordance with the established milestone dates.

5.1.3 INITIATIVE CONSTRAINTS:

- The Airport Improvement Program only authorizes funding of public-use facilities which excludes police and hospitals heliports (See Order 5090.3B, Field Formulation of the National Plan of Integrated Airport Systems (NPIAS), paragraph 203). Therefore, non-Federal/private funding or a change in policy may be required to accomplish part of this initiative.

5.2 INITIATIVE: Develop "rotorcraft only" GPS approach procedures to facilitate simultaneous rotorcraft and fixed-wing operations.

5.2.1 The existing system inefficiently mixes slow and fast aircraft into a single approach funnel which effects an overall slowdown of traffic, reduces capacity, and produces delays. That inefficiency often relegates relatively slower rotorcraft to a secondary status within the existing system. To put rotorcraft access on a par with that of fixed-wing aircraft necessitates the development of separate rotorcraft approaches and procedures which do not impact, or minimally impact, aircraft using current procedures. GPS affords the opportunity to provide reasonably inexpensive, nonprecision approaches to countless locations heretofore deemed impractical or cost prohibitive. The point-in-space approaches may become the solution at some locations; however, nonprecision approaches directly to heliports/vertiports improve on point-in-space approaches by allowing the completion of IFR flight by a landing, versus the transition from IFR to VFR/SVFR flight. Lastly, precision approaches will provide an all-weather capability. **(Near/Mid-Term)**

5.2.2 TECHNICAL APPROACH: This technical approach develops interim procedures for nonprecision, including point-in-space, and precision approaches specifically designed to use the intrinsic flight characteristics of rotorcraft, validated through testing, and used to develop and promulgate new ATC procedures. To ensure continuity of effort, this approach additionally supports the rotorcraft master plan project for terminal area procedures and other DOT/FAA efforts pertaining to rotorcraft ATC route standards (see paragraph 5.1.2 above). It also, in part, supports the FAA Satellite Navigation Program Master Plan (FY 93-98) to investigate augmentations to GPS for CAT I precision approaches to support all categories of flight. It will align with the ARD-30 VERTAPS project to provide synergism and preclude duplication.

5.2.2.1 Benefits and/or costs: ATP-20, in conjunction with ARD-30, shall ensure that a detailed benefit/cost analysis is prepared to establish the cost effectiveness of this initiative. The three reports listed in paragraph 5.1.2.1 should be the basis of the analysis. The analysis will compare the benefits of the various types of approaches and delineate the relative efficiency and cost effectiveness of each type of approach. The analysis will provide separate and distinct data to support the approach benefits for EMS/H missions.

5.2.2.2 Development of a test plan/demonstration: The test plan shall be developed with the full coordination of ARD-30, ARD-70, and the various Air Traffic services, plus other organizations as required (AAF, AFS, AAP, etc.). ATP-20 shall ensure that the plan identifies, at the minimum, necessary equipment, staffing, interim procedures, and test/demonstration site(s).

Note: A flight test plan (December 1992) for helicopter terminal instrument approach procedures (GPS/LDGPS) has been prepared by FAATC/ACD-330 and could be modified to support this technical approach. The modified plan should include, but not be limited to the following:

- Overlay and/or modify Northeast corridor RNAV point-in-space approaches to include those that could serve hospitals or other emergency facilities. **(Near/Mid-Term)**
- Develop and validate approaches directly to heliports/vertiports within a major airport environment. This should include establishing approaches for hospitals among which EMS/H missions are routinely flown. **(Near/Mid-Term)**
- Examine GPS with LDGPS capabilities for rotorcraft use and develop special precision approaches to heliports. Initially, this will be limited to a "proof of concept." **(Near-Term)**
- Ensure that this initiative is fully coordinated and integrated with other initiatives that will use the Northeast corridor as a test bed.
- Ensure the test results are reviewed in close coordination with ATM, AFS, ARD-30, ARD-70, FAATC/ACD-330, and the region(s).

5.2.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20, in coordination with **ATP-100,** shall ensure the development of ATC procedures and make changes to FAA documents in concert with test results and approved recommendations.

5.2.2.4 Training requirements for air traffic controllers: ATP-20, through **ATZ,** shall ensure the development and dissemination of any requisite training as procedural and/or document changes warrant.

5.2.2.5 Final coordination requirements: ATP-20 shall coordinate with **ATP-200** to ensure all procedural and editorial changes have been published and disseminated in accordance with the established milestone dates.

5.2.3 INITIATIVE CONSTRAINTS:

- The Airport Improvement Program only authorizes funding of public-use facilities which exclude police and hospital heliports (See Order 5090.3B, Field Formulation of the National Plan of Integrated Airport Systems (NPIAS), paragraph 203). Therefore, part of this initiative may not be accomplished unless non-Federal/private funding or a change in policy is obtained.
- The decision to procure Federal, public-use LDGPS is not scheduled to be made until 1998; therefore, proliferation of the precision capability to heliports/vertiports seems unlikely under this implementation plan.

5.3 INITIATIVE: Establish and certify "rotorcraft only" STAR's to enhance the flow of both fixed-wing and rotorcraft traffic within the terminal area.

5.3.1 STAR's developed especially for rotorcraft will allow pilots to navigate on their own, reduce controller workload, and improve the flow of aircraft within the terminal area. **(Near- through Far-Term)**

5.3.2 TECHNICAL APPROACH: This technical approach develops interim procedures for transition routes, SID's, and STAR's that will be validated through tests or demonstrations and be used as the basis to effect new ATC procedures. The approach supports ongoing projects of the rotorcraft master plan concerning transition routes and procedures and terminal area procedures. This approach also aligns with the technical approach in paragraph 1.2.

5.3.2.1 Benefits and/or costs: ATP-20, in conjunction with ARD-30, shall ensure the development of a detailed benefit/cost analysis to establish the cost effectiveness of this initiative. The three reports listed in paragraph 5.1.2.1 should be the basis of the analysis.

5.3.2.2 Development of a test plan/demonstration: The test/demonstration plan(s) shall be developed with full coordination of ARD-30 and the various Air Traffic services, plus other organizations as required (AAF, AFS, AAP, etc.). ATP-20 will ensure the jointly-developed plan(s) identifies necessary equipment, staffing, interim procedures, and test/demonstration site(s). The plan(s) should include, but not be limited to the following:

- Establish IFR transition routes between the Northeast corridor and conventional instrument approaches to heliports/airports. **(Near/Mid-Term)**
- Parlay the previous step by linking the transition routes with newly-developed "rotorcraft only" nonprecision GPS approaches to an intercept point which would modify current approach procedures in order to reduce separation criteria at a major airport. **(Mid-Term)**
- Develop "rotorcraft only" SID's to expedite traffic flow from the terminal area. **(Mid-Term)**
- Export follow-on phases of this approach from the Northeast corridor to other parts of the NAS as was done in paragraph 5.1.2 above. **(Mid/Far-Term)**
- Ensure that this initiative is fully integrated with other initiatives that will use the Northeast corridor as a test bed.
- Ensure that Air Traffic and the regions evaluate the collective test results.

5.3.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20, in coordination with ATP-100, shall ensure the development of ATC procedures and make changes to FAA documents in concert with test/demonstration results and approved recommendations.

5.3.2.4 Training requirements for air traffic controllers: ATP-20, through **ATZ,** shall ensure the development and dissemination of any requisite training as procedural and/or document changes warrant.

5.3.2.5 Final coordination requirements: ATP-20 shall coordinate with **ATP-200** to ensure all procedural and editorial changes have been published and disseminated in accordance with the established milestone dates.

5.3.3 INITIATIVE CONSTRAINTS: See paragraphs **1.1.3** and **1.2.3** for details.

5.4 INITIATIVE: Develop an interim CNS capability to support offshore oil complexes.

5.4.1 The majority of rotorcraft offshore missions are flown under **VFR** in the Gulf of Mexico; however, some requirements exist for other rotorcraft missions to be conducted in **IFR** conditions. The current **IFR** structure, although supported by LORAN-C, has limited routings and approach capabilities and communications and surveillance limitations. This requires the use of separation standards that cause delays which are inconvenient, inefficient, and costly. As a result, operators shy away from **IFR** missions unless absolutely necessary. Using **GPS,** rotorcraft routes for direct/optimized flights and nonprecision approaches to specific locations or points-in-space would reduce delays and facilitate and improve **IFR** flight. At the same time, **GPS** implementation will enhance current capabilities or effect alternative solutions to modernize offshore communications and surveillance capabilities.
(Mid/Far-Term)

5.4.2 TECHNICAL APPROACH: A "proof of concept" has been validated in Norway wherein a rotorcraft, equipped with a **GPS** transponder and VHF data link, had its position transmitted to a receiver linked to a computer and displayed on a scope/screen in an air route traffic control center. **ATP-20** shall ensure coordination among the services and the region(s) to further explore this concept using offshore helicopter support and Houston **ARTCC** assets. Additionally, United States Coast Guard **GPS** differential system capabilities, to include any attendant communications or surveillance, should be used. Further, this approach could parlay data derived from the Northeast corridor test beds to establish/upgrade the offshore route and approach structure. For example, **GPS** routing could be used to overlay current north-south helicopter routes and establish new east-west routes, plus develop direct links among the oil platforms. Similarly, procedures developed and validated for **GPS** nonprecision approaches could be applied to provide an alternative to the offshore standard approach procedures **(OSAP)** or to establish approach capabilities directly to oil platforms.

5.4.2.1 Benefits and/or costs: **ATP-20,** in coordination with **ARD-30,** shall ensure that a detailed benefit/cost analysis is undertaken to establish the cost effectiveness of this initiative.

Note: To support a rotorcraft master plan project, **ARD-30** currently is coordinating an action to ascertain the costs and benefits of providing additional communications and surveillance at low altitude. Additionally, a cost/benefit analysis was completed in **1991** for a similar concept, LORAN offshore flight following **(LOFF).** Either may be a suitable basis for the above analysis.

5.4.2.2 Development of a test plan/demonstration: ATP-20, assisted by **ATP-100** and **ARD-30,** will ensure the jointly developed test/demonstration plan(s) identifies necessary equipment, including helicopters equipped with **GPS** transponders and VHF data links, VHF relays, computers/automation with screens/scopes, staffing, interim procedures, and test/demonstration site(s). Additionally:

- Develop the plan(s) with full coordination of the various Air Traffic services and Houston **ARTCC,** plus other organizations as required **(AAF, AFS, AAP,** etc.).
- Use the Norwegian **CNS/GPS** trials (the modified ADS or **"MADS"** project) experience and data as the basis to establish and conduct trials and/or testing in the Gulf of Mexico. Also, use data from the **LOFF** tests involving Houston **ARTCC.**
- Use a graduated, three-phased approach to give:
  - Flight following
  - Traffic advisories
  - Full **IFR** service and tracking
- Ensure that this initiative is fully coordinated with other implementation plan initiatives to include those that will use the Northeast corridor as a test bed.
- Ensure that Air Traffic and the region(s) evaluate results of all applicable demonstrations and tests.

5.4.2.3 Develop necessary ATC procedural and/or editorial changes required to support the initiative: ATP-20, in coordination with **ATP-100,** shall ensure the development of **ATC** procedures and make changes to FAA documents in concert with test/demonstration results and approved recommendations.

5.4.2.4 Training requirements for air traffic controllers: ATP-20, through **ATZ,** shall ensure the development and dissemination of any requisite training as procedural and/or document changes warrant.

5.4.2.5 Final coordination requirements: Prior to implementation, **ATP-20** shall coordinate with **ATP-200** to ensure all procedural and editorial changes have been published and disseminated.

ATP-20, in coordination with **ATP-100** and **ARD-30,** will also ensure that other implementation requirements meet established milestone dates.

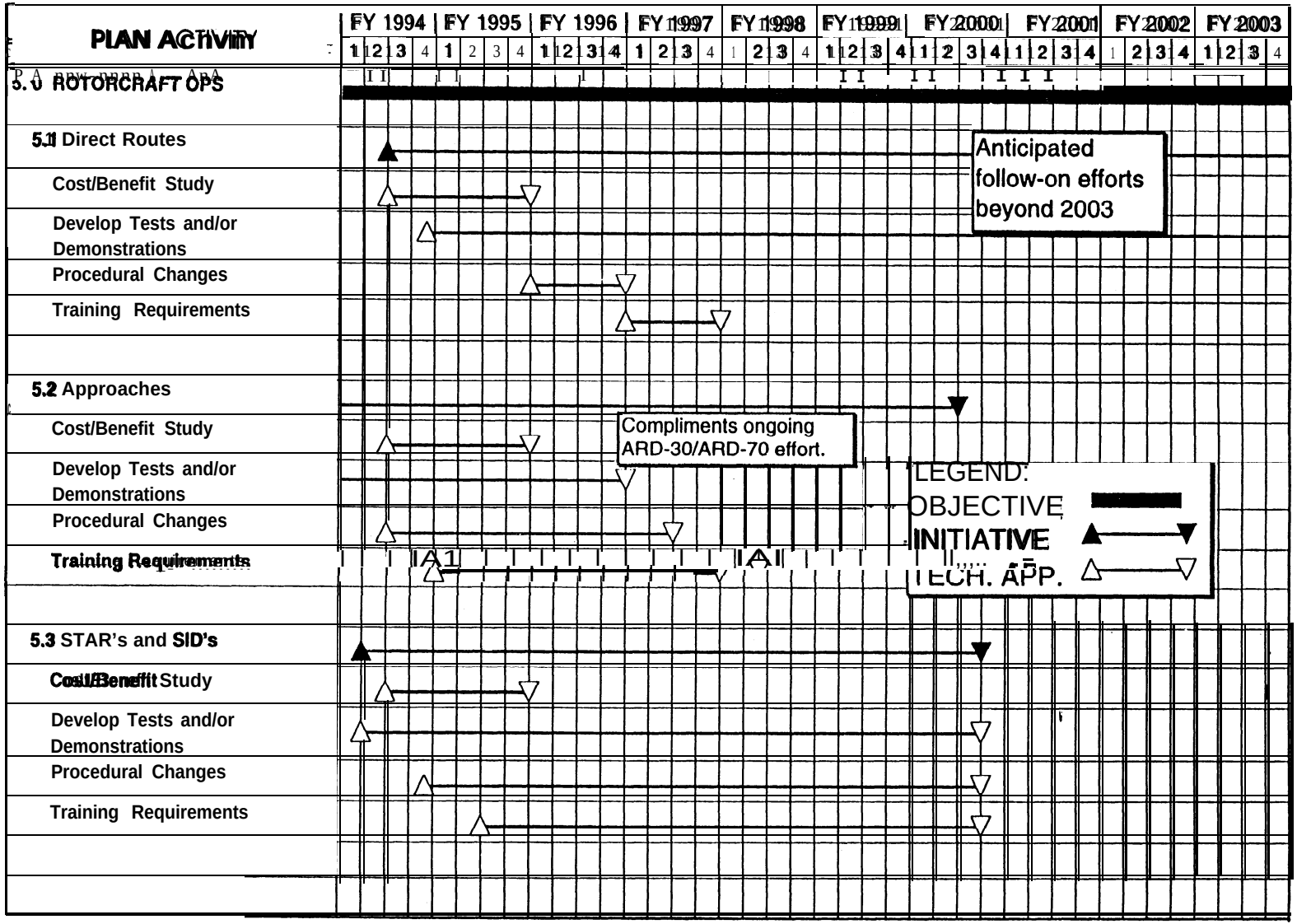
5.4.3 INITIATIVE CONSTRAINTS:

- FAA recently stopped funding its LOFF program, a similar and viable near-term CNS capability for the Gulf of Mexico which had attained favorable test results.

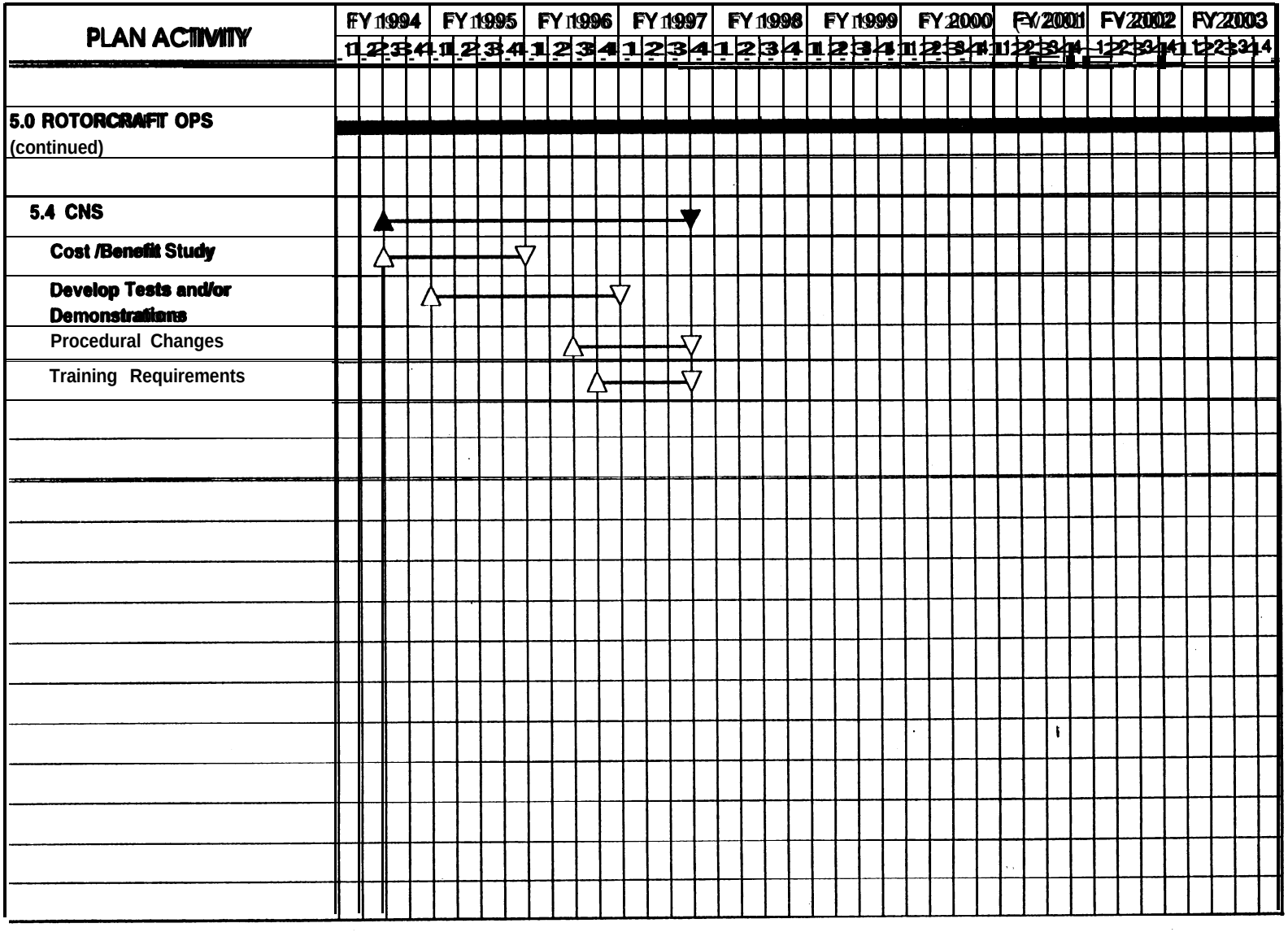
- This initiative does not align with the users' priorities. Overall, their first priority is to upgrade the capabilities in the Northeast. Within the Gulf, current private tracking systems, such as "Flite-Track" and "Inflite Tracking," already support a working offshore infrastructure. There, the users' top priorities are to improve communications and establish GPS approaches to mainland facilities. Until those improvements are made, VFR rotorcraft flights will continue to be the norm for the sake of expediency and economy.

- The Airport Improvement Program authorizes funding of public-use facilities but not of private facilities such as those for offshore oil complexes. Hence, private funding will be required to improve approach capabilities and IAP's for offshore platforms.

OBJECTIVE 5.0 - USE THE CAPABILITIES OF GPS TO PROVIDE ENHANCED AND MORE PRECISE AIR TRAFFIC SERVICES TO ROTORCRAFT OPERATIONS



OBJECTIVE **5.0 - USE THE CAPABILITIES OF GPS TO PROVIDE ENHANCED AND MORE PRECISE** AIR TRAFFIC SERVICES TO ROTORCRAFT OPERATIONS



APPENDIX 5 - GLOSSARY

Accuracy--The degree of conformance between the estimated or measured position and/or velocity of a platform at a given time and its true position or velocity. Radionavigational-system accuracy is usually presented as a statistical measure of system error and is specified as:

a. Predictable-The accuracy of a position with respect to the geographic or geodetic coordinates of the earth.

b. Repeatable-The accuracy with which a user can return to a position having coordinates which have been measured previously with the same navigational system.

c. Relative-The accuracy with which a user can measure position relative to that of another user of the same navigational system at the same time. This may be expressed also as a function of the distance between the two users. Relative accuracy may also refer to the accuracy with which a user can measure position relative to his own position in the recent past. For example, the present position of a craft whose desired track forms a specific geometric pattern in search operations or hydrographic survey will be measured generally with respect to a previously determined datum.

Active Waypoint--A waypoint to or from which navigational guidance is being provided. For a parallel offset, the active waypoint may or may not be at the same geographical position as the parent waypoint. When not in the parallel offset mode (operating on the parent route), the active and parent waypoints are at the same geographical position.

Air Traffic Control (ATC)--A service operated by appropriate authority to promote the safe, orderly, and expeditious flow of air traffic.

Approaches:

a. Nonprecision approach--A standard instrument approach procedure in which no electronic glideslope is provided; e.g., VOR, TACAN, NDB, LOC, ASR, LDA, or SDF approaches.

b. Precision approach--A standard instrument approach procedure in which an electronic glideslope is provided; e.g., ILS/MLS and PAR.

Approved Sole-Means Navigational System--A navigational system which is approved by the regulatory authorities for sole means navigational operation for a particular phase of flight.

Approved Supplemental Means Navigational System--A navigational system which is approved by the regulatory authorities for supplemental navigational system operation for a particular phase of flight.

Area Navigation (RNAV)--Application of the navigational process providing the capability to establish and maintain on any arbitrary chosen course that remains within the coverage area of navigational sources being used. RNAV utilizing capabilities in the horizontal plane only is called 2D RNAV, while RNAV, which also incorporates vertical guidance, is called 3D RNAV or VNAV. Time navigation (TNAV) may be added to either 2D or 3D systems. TNAV added to a 3D system is called 4D.

Augmentation (of GPS)--GPS augmentation is the technique of providing the system with input information, extra to that derived from the constellation, which provides additional range/pseudo-range inputs or corrections to, or enhancements of, existing pseudo-range inputs. This enables the system to provide a performance which is enhanced relative to that possible with the basic satellite information only.

Availability--The availability of a navigational system is the percentage of time that the services of the system are usable. Availability is an indication of the ability of the system to provide usable service within the specified coverage area. Signal availability is a function of both the physical characteristics of the environment and the technical capabilities of the transmitter facilities.

Barometric Aiding--The technique of providing barometric altitude as an input to a GPS receiver.

Basic Flight Management System (FMS)--As a minimum, a basic FMS is considered to be a single (nonredundant) system, integrated with a horizontal situation indicator (HSI), that provides 3D navigational capability .

Bearing--The direction of an object relative to a line between the airplane and north (magnetic or true).

Carrier-aided tracking--A signal processing strategy that uses the GPS carrier signal to achieve an exact lock on the pseudo-random code. It is more accurate than a standard approach.

Carrier Phase Tracking Receiver--A receiver which, in addition to using normal data processing techniques all or part of the time, continuously tracks the carrier phases of navigational satellites and uses the resulting measurements to calculate its navigational solution.

Continuity of Service--The probability that a navigational system will be continuously available for a specified period of time; e.g., 15 seconds for precision approaches or for the duration of a flight for en route flight, given that the system is operating normally (or in a way in which a given flight operation would be permitted) at the beginning of such period and is predicted to remain so throughout the period.

Coverage--The coverage provided by a radionavigational system is that surface area or space volume in which the signals are adequate to permit the user to determine position to a specified level of accuracy. Coverage is influenced by system geometry, signal power levels, receiver sensitivity, atmospheric noise conditions, and other factors which affect signal availability.

Data Message--A message included in the GPS signal which reports the satellite's location, clock corrections, and health. Included is rough information on the other satellites in the constellation.

Differential--A technique used to improve radionavigational system accuracy by determining positioning error at a known location and subsequently transmitting the determined error, or corrective factors, to users of the same radionavigational system operating in the same area.

a. Local Area Differential--Differential in which the differential corrections are usable for the supported phases of flight within a limited geographical area.

b. Wide Area Differential--Differential where the differential corrections are usable over an extensive geographical area for the supported phases of flight.

Enhanced FMS--As a minimum, an enhanced FMS should include the capability of standard FMS with the Global Navigation Satellite System (GNSS). It should be capable of handling differential Global Positioning System (GPS)/GNSS as an input sensor, achieving very high levels of integrity and accommodating new techniques such as GPS-carrier phase tracking (if proven beneficial). In addition, enhanced FMS should have software which meets flight critical levels to support CAT III and other critical procedures along with other advancements fully integrated for such features as data link, etc.

En Route--A phase of navigation covering operations between a point of departure and termination of a mission. For airborne missions, the en route phase of navigation has two subcategories:

a. En route domestic--The phase of flight between departure and arrival terminal phases, with departure and arrival points within the conterminous United States.

b. En route oceanic--The phase of flight between departure and arrival terminal phases, with an extended flight path over ocean.

External Reference Sensors--Depend on navigational aids external to the aircraft; e.g., VOR/DME, ILS, MLS, ADF, LORAN, Omega, etc.

Flight Management System (FMS)--An integrated computer system which has both a navigational function and performance data base offering optimum performance tracking by generating guidance signals for the autopilot. It is a true dual-axes controller in a two-dimensional plane and may offer vertical and time control. Possible classifications are basic FMS, standard FMS, standard FMS with GNSS, and enhanced FMS.

Global Navigation Satellite System (GNSS)--GNSS is a worldwide concept for position, velocity, and time determination system that includes one or more satellite constellations, receivers, and system integrity monitoring. GNSS may be augmented as necessary to support the required navigational performance for the actual phase of operation.

Global Positioning System (GPS)--A space-based positioning, velocity, and time system composed of space, control, and user segments. The space segment, when fully operational, will be composed of 24 satellites in six orbital planes. The control segment consists of five monitor stations, three ground antennas, and a master control station. The user segment consists of antennas and receiver-processors that provide positioning, velocity, and precise timing to the user.

Integrity--The ability of the total navigational system to provide timely warnings to users when the system should not be used for navigation.

Multichannel Receiver--A GPS receiver that can simultaneously track more than one satellite signal.

National Airspace System (NAS)--The NAS includes U.S. airspace; air-navigational facilities, equipment and services; airports or landing areas; aeronautical charts, information, and service; rules, regulations and procedures; technical information; and labor and material used to control and/or manage flight activities in airspace under the jurisdiction of the U.S. System components shared jointly with the military are included.

Navigation--The means by which an aircraft is given guidance to travel from one known position to another known position.

Navigational System--A stand-alone (single sensor), external or internal reference, with a cockpit controller or control display unit (CDU) and a navigational data base. Types of navigational systems include: stand-alone systems (e.g. multichannel sets, single channel sets), integrated navigational receivers, and FMC imbedded sensor systems.

Navigational System Performance--Total navigational system accuracy based on the root-sum-square (RSS) of the navigational sensor error, airborne receiver error, display error, and flight technical error.

P-Code--The precise code. A very long sequence of pseudo-random binary biphase modulations on the GPS carrier at a chip rate of 10.23 Mhz which repeats about every 267 days. Each 1 week segment of this code is unique to one GPS satellite and is reset each week.

Phase of Flight--A period of navigation with a constant required navigational performance. Flight phases include departure, en route, terminal, approach, and landing.

Phase **of Operation--A** phase of operation is a period of navigation with a constant required navigational performance (RNP).

Primary Means of Navigation--Primary means of navigation is a term used to identify a system within a multisensor system or a specific stand-alone system among several systems that will be the normal system used to navigate the aircraft. Installations that have a designated "primary means" should have an advisory indication specifying which system is being used to compute the aircraft position and provide a means to switch to another system should it become necessary or appropriate.

Primary Navigational System--An FAA-approved navigational system that can be used for specific phases of air navigation in controlled airspace without the need for any other navigational system.

Pseudolite--A ground-based augmentation which provides, on satellite signal-in-space radio frequencies, an additional navigational-ranging signal and, optionally, differential corrections.

Receiver Autonomous Integrity Monitoring (RAIM)--A technique whereby a civil GPS receiver/processor determines the integrity of the GPS navigational signals without reference to sensors or non-DOD integrity systems other than the receiver itself. This determination is achieved by a consistency check among redundant pseudo-range measurements.

Reliability--The probability of performing a specified function without loss of function under given conditions for a specified period of time.

Required Navigational Performance (RNP)--A measure of the navigational system performance within a defined airspace including the operating parameters of the navigational systems used within that airspace.

RNAV Route--An en route segment and arrival or departure routes including RNAV SID's and STAR's. It may also include en route segments established with gaps in station coverage for use by RNAV-equipped aircraft capable of automatic dead reckoning.

Route Segment--Two subsequently related waypoints or ATC fixes define an RNAV route segment.

Satellite Constellation--The arrangement in space of a set of satellites.

Secondary Sensor--Any input from other aircraft systems that may be used to derive navigational information.

Selective Availability (SA)--A set of techniques for denying the full accuracy and selecting the level of positioning and time accuracy of GPS available to unauthorized users.

Sole Means Air Navigational System--An approved navigational system that can be used for specific phases of air navigation in controlled airspace without the need for any other navigational system.

Sole Means of Navigation--A means of navigating the aircraft where position determination is provided by a system which satisfies the required navigational performance (RNP) for a particular phase of flight.

Space Segment--That portion of the global positioning system that is in space, i.e., the satellites.

Stand-Alone Navigational Equipment--Stand-alone navigational equipment represents a single navigational system that has a dedicated display and is not coupled to or integrated with another aircraft system.

Standard FMS--As a minimum, a standard FMS is considered to be a dual redundant system, integrated with an enhanced HSI that provides redundant 3D capability.

Standard FMS With GNSS--A standard FMS with GNSS added as an input sensor.

Standard Positioninn Service (SPS)--The normal civilian positioning accuracy obtained by using the single frequency course acquisition (C/A) code.

Sup&mental Air Navigational System--An approved navigational system that can be used in controlled airspace of the NAS in conjunction with a sole means navigational system.

Terminal Area--A general term used to describe airspace in which approach control service or airport traffic control service is provided.

TO-FROM Equipment--RNAV equipment in which the desired path over the ground is defined as a specific (input quantity) course emanating either to or from a particular waypoint. In this equipment, the aircraft may fly either "TO" or "FROM" any single designated waypoint.

TO-TO Equipment--RNAV equipment in which a path is computed that connects two waypoints. In this equipment, two waypoints must always be available, and the aircraft is usually flying between the two waypoints and "To" the active waypoint.

Waypoint (W/P)--A predetermined geographical position used to define routes and/or progress reporting fixes that is defined by latitude and longitude and/or relative to a VORTAC or VOR/DME reference facility by magnetic radial bearing and range in nautical miles.

World Geodetic Survey (WGS)--A consistent set of parameters describing the size and shape of the earth, the positions of a network of points with respect to the center of mass of the earth, transformations from major geodetic datums, and the potential of the earth (usually in terms of harmonic coefficients).

APPENDIX 6 - ABBREVIATIONS/ACRONYMS

AAF	Airway Facilities
AAP	Program Manager for Advanced Automation
AAS	Advanced Automation System
AC	Advisory Circular
ADS	Automatic Dependent Surveillance
AFS	Flight Standards Service
AIR	Aircraft Certification Service
AMASS	Airport Movement and Surveillance System
AOAS	Advanced Oceanic Automation System
ARD	Research and Development Service
ARSA	Airport Radar Service Area
ARTCC	Air Route Traffic Control Center
ASDE	Airport Surface Detection Equipment
ASTA	Airport Surveillance Traffic Automation
ATC	Air Traffic Control
ATCAA	Air Traffic Control Assigned Airspace
ATM	Air Traffic System Management, Office of
ATN	Aeronautical Telecommunications Network
ATP	Air Traffic Rules and Procedures Service
ATR	Air Traffic Plans and Requirements Service
ATS	Air Traffic Service
ATZ	Air Traffic Program Management, Office of
AVN	Aviation System Standards, Office of
CAT I	Category I Approach
CAT II	Category II Approach
CAT III	Category III Approach
CNS	Communications, Navigation, and Surveillance
CTA	Control Area
CTAS	Center TRACON Arrival Sequencing
DME	Distance Measuring Equipment
DOD	Department of Defense
DOT	Department of Transportation
EMS/H	Emergency Medical Service/Helicopter
ESD	Enhanced Situation Display
FAA	Federal Aviation Administration
FAATC	FAA Technical Center
FIAO	Flight Inspection Area Office
FIR	Flight Information Region
FMS	Flight Management System
GIC	GPS Integrity Channel
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IAP	Instrument Approach Procedures
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
IOC	Initial Operational Capability

ISSS	Initial Sector Suite System
IFR	Instrument Flight Rules
LORAN-C	Long-range Navigation-C System
LADGPS	See **LDGPS**
LDGPS	Local Area Differential **GPS**
LOFF	LORAN Offshore Flight Following
MADS	Modified ADS
MAMS	Military Airspace Management System
MAPS	Missed Approach Points
MASPS	Minimum Aviation System Performance Standards
MEA	Minimum En Route Altitude
MOA	Military Operations Area
MOCA	Minimum Obstruction Clearance Altitude
MOPS	Minimum Operational Performance Standards
MRA	Minimum Reception Altitude
MTRS	Military Training Routes
NAS	National Airspace System
NAVAID	Navigational Aid
NDB	Nondirectional Beacon
NOTAM	Notice to Airmen
NPIAS	National Plan of Integrated Airport Systems
ODL	Oceanic Data Link
OSAP	Offshore Standard Approach Procedures
OST	Oceanic Standards Team
PANS	Procedures for Air Navigation Service
PPS	Precise Positioning System
RAIM	Receiver Autonomous Integrity Monitoring
RNAV	Area Navigation
RNP	Required Navigational Performance
ROC	Required Obstruction Clearance
RTCA	Requirements and Technical Concepts for Aviation, Inc.
RVSM	Reduced Vertical Separation Minima
SA	Selective Availability
SATCOM	Satellite Communications
SCAT-I	Special Category I Approach
SID	Standard Instrument Departure
SOIT	Satellite Operational Implementation Team
SPS	Standard Positioning System
STAR	Standard Terminal Arrival
SUA	Special Use Airspace
SVFR	Special Visual Flight Rules
TACAN	Tactical Air Navigation
TATCA	Terminal Air Traffic Control Automation
TCA	Terminal Control Area
TLS	Target Level of Safety
TP	Telecommunications Processor
TSO	Technical Standard Order
USCG	United States Coast Guard
VERTAPS	Vertical Flight Terminal Area Procedures

VFR	Visual Flight Rules
VHF	Very High Frequency
VOR	VHF Omnidirectional Range
VORTAC	VHF Omnidirectional Range Tactical Air Navigation
WDGPS	Wide Area Differential GPS

APPENDIX 7 - REFERENCES

The documents listed below were used as research, material for this plan. Each document was individually reviewed for data that could be used in aiding the authors in determining the objectives and initiatives of the plan. Many of the documents contained material that was very beneficial in developing the plan, while others had information, that could not be used at this time.

1. RTCA Task Force Report on the Global Navigation Satellite System (GNSS) Transition and Implementation Strategy.

2. Satellite Navigation Concepts for Early Implementation: The Federal Aviation Administration (FAA) View: August 1992.

3. FAA Satellite Navigation Program Plan: FY 92-97.

4. Investigation of Global Positioning System (GPS) by the Automatic Dependent Surveillance (ADS) System: February 1992.

5. U.S. National Aviation Standard for the Global Positioning System Standard Positioning Service, DRAFT: April 1992.

6. ICAO 10th Air Navigation Conference Agreements.

7. CNS/ATM/SG/2 Report.

8. Introduction to the Global Positioning System, Overlook Systems Technology, Inc.: 1992 and 1993.

9. Draft, Annex 1, Satellite Navigation Operational Implementation Plan (SOIP): December 3 1, 1992.

10. Draft, Annex 2, Satellite Communications Operational Implementation Plan (SOIP): December 11, 1992.

11. Draft, Annex 3, (SOIP): November 16, 1992.

12. Federal Policy and Plans for the Future Radionavigation Systems Mix: 1992.

13. Memorandum of Agreement Between the Department of Defense and the Department of Transportation, Civil Use of the Global Positioning System: December 14, 1992.

14. Memorandum of Agreement Between the Department of Defense (DOD) and the Federal Aviation Administration (FAA), Use of the Global Positioning System in the National Airspace System (NAS): March 13, 1992.

15. The ICAO CNS/ATM System: A View to the Future, Draft: No date available.

16. Special Committee for the Monitoring and Coordination of Development and Transmission Planning for the Future Air Navigation System (FANS Phase II) Third Meeting: April 13, 1992.

17. Automatic Dependent Surveillance Panel (ADSP), Second Meeting: June 22, 1992, including the Addendum/Corrigendum No. 1: July 15, 1992.

18. The Future of Oceanic Air Traffic Management: A Shared Vision: July 1992.

19. A Weather Vision to Support Improved Capacity, Efficiency and Safety of the Air Space System in the Twenty-First Century: April 1992.

20. Oceanic Standards Team (OST) FAA/ATA Working Group Minutes of Meeting #4: November 17, 1992.

21. Concept of Operations: A Description of the Baseline Oceanic ATC System: December 1992.

22. FAA Satellite Navigation Program Master Plan: FY 93-98.

23. The Phasing of Services Leading to the ADLC Vision: February 18, 1993.

24. GNSS/Mode-S Precision Monitor System: No date available.

25. L-Band Mobile Terminal Antennas for Helicopters, Jet Propulsion Laboratory: No date available.

26. Draft Satellite Voice Test Plan: January 25, 1993.

27. FAA FY 93-97 Satellite Communications Program Plan: February 19, 1993.

28. Phased Implementation of Air Traffic Services via Datalink: February 16, 1993.

29. SC-165/WG5 Satellite Voice Communications, Guidance on AMS(R)S Voice Implementation and Utilization (1st. Draft): March 14, 1993.

30. FAA Position on the Use of SATCOM Voice for Oceanic ATC: No date available.

31. The Aeronautical Data Link System Vision: The Key to Future Air Traffic Services: March 4, 1993.

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